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THE PATHOLOGY OF RADIUM BURNS

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There is no question of the vast amount of good done and the remarkable cures effected by radium when used therapeutically, but the fact should be emphasized that there is another side to the question and that frequently instead of a cure a burn results, which in many instances is worse than the original lesion. Few physicians who refer patients for radium therapy know what the ultimate outcome is, so far as changes in the tissues are concerned.

It is my purpose in this paper to point out the pathologic changes in the tissues by which radium burns are brought about. Very small doses of radium were used so that the changes noted would be gradual and thus they could be more carefully studied and the steps in the pathologic changes from engorgement and dilatation of the vessels to thrombosis and necrosis could be seen.

The stages in the development of a radium burn may be classified in three main divisions as follows:

1. The stage of engorgement, followed by an increase in the number of polymorphonuclear leukocytes and their migration to the surrounding tissue. Associated with this is an increase in the blood flow in this area.

2. The stage of constriction of the vessels, followed by edema of the endothelial lining, injury to the vessels of the walls and thrombosis. The flow of blood stream at this stage is slow; the capillaries have become thrombosed or have been occluded owing to the edema of the walls, and the larger arterioles and arteries are the only vessels which are functioning.

3. As a direct result of the second condition and a later injury to the larger vessels, necrosis of the tissue takes place owing to the loss of blood supply.

These stages in the development of radium burns in general correspond to the degrees of severity of burns resulting from fire.

Burns resulting from fire may be classified as burns of the first degree, characterized by hyperemia of the exposed surface, which corresponds to the first stage of a radium burn; burns of the second degree,

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The photomicrographs were made by Dr. Werner Mueller.

From the Mosher Laboratory, Massachusetts Eye and Ear Infirmary.

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characterized by extravasation of serum and colliquation of certain cells leading to the formation of vesicles, and third degree burns, extending deeper than the burns of the first and second degrees and characterized by coagulation of the cytoplasm of the cells which results in necrosis of the tissue.

Following an extensive superficial burn by fire, the withdrawal of large quantities of serum from the blood is followed by anhydremia with hemolysis and a tendency to thrombosis. In the radium burn necrosis is due not primarily to an injury of the tissues but to injury of the

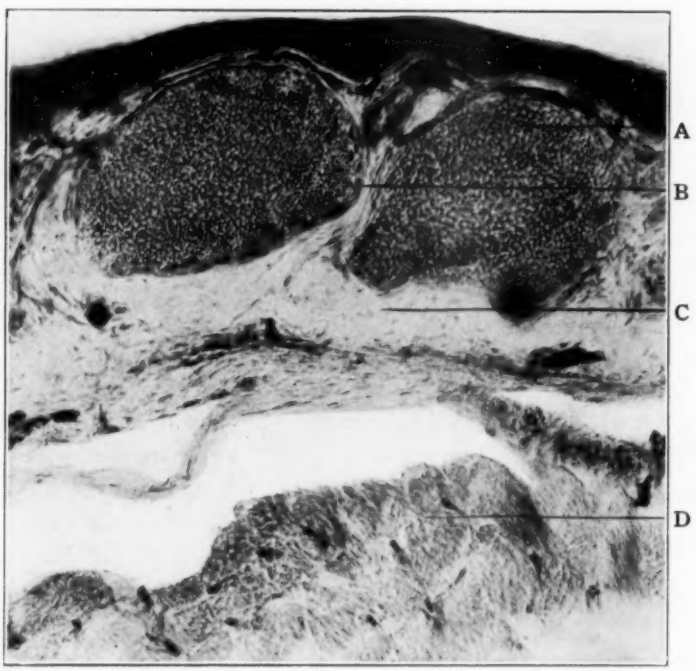

Fig. 1.—Tissue after a small amount of radium has been applied for twenty-four hours. *A* indicates an engorged vessel; *B*, an endothelial cell; *C*, edema, and *D*, cloudy swelling. Note the normal fibrous tissue at this stage.

endothelial cells and thrombosis with necrosis of the tissue due to lack of blood supply.

The difficulty in determining the degree of a burn caused by radium is due to the gradual change that takes place in the tissue and to the fact that the tissue is injured only by an overwhelming dose. The changes which take place early occur in the blood vessels. Hyperemia results at first (fig. 1). The vessels are greatly engorged; the walls are thin, and some edema occurs about them. The skin is slightly contracted as compared with normal skin. The fibrous tissue and underlying structures

appear to be normal, no changes being noted except so far as the vessels are concerned. A little further in the process, as seen in figure 2, the vessels are greatly engorged, the cells being almost packed in the vessel. The walls of these vessels are very thin and appear almost as an endothelial lining. The edema is more marked about the vessels at this period, and the subepithelial fibrous tissue is contracted. This change may readily be compared with that shown in figure 1.

A later stage shows the vessels contracted (fig. 3), and whereas there are few polymorphonuclear leukocytes in the first two stages, there are many now. The vessels just beneath the skin are small, and the endothelial cells begin to show some edema. The subepithelial fibrous

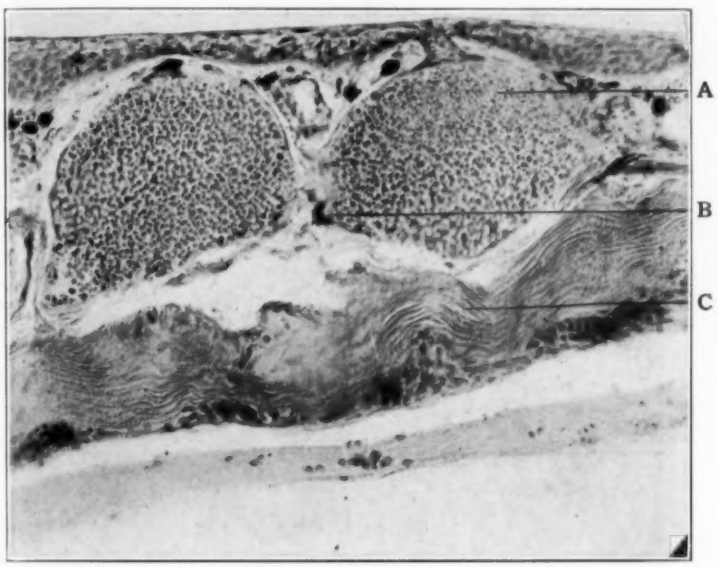

Fig. 2.—A slightly later stage than that depicted in figure 1, showing greater engorgement of the vessels, slightly more edema and some changes beginning in the muscles. *A* indicates an engorged vessel; *B*, an endothelial cell, and *C*, fibrous tissue.

tissue is more compact, and the subcutaneous tissue is denser and paler. Already, owing to the constriction of the blood vessels, a change is beginning to take place in the subcutaneous fibrous tissue and some hyaline degeneration is evident. However, this is very slight; in cases in which an erythema dose is given, if irradiation is carried too far, this stage is reached. If let alone, the vessels become normal and no noticeable change is evident in the tissue either macroscopically or microscopically. If, on the other hand, the tissue is further subjected to irradiation with radium, more marked changes occur which in the long run result in definite changes in the tissue which are irreparable. This is seen in

figure 4, in which the vessels are shown to be greatly constricted and full of leukocytes. In one or two of these vessels thrombosis is already taking place. There has been a migration of the leukocytes to the surrounding tissue, and owing to the lack of blood supply a cloudy swelling of the tissue is taking place. Of note here is the change that is beginning to take place in the muscles. Whereas in the section of normal tissue the muscles are deep-staining, in figure 5 they are paler and the nuclei show definite changes, as of pyknosis. The muscle bun-

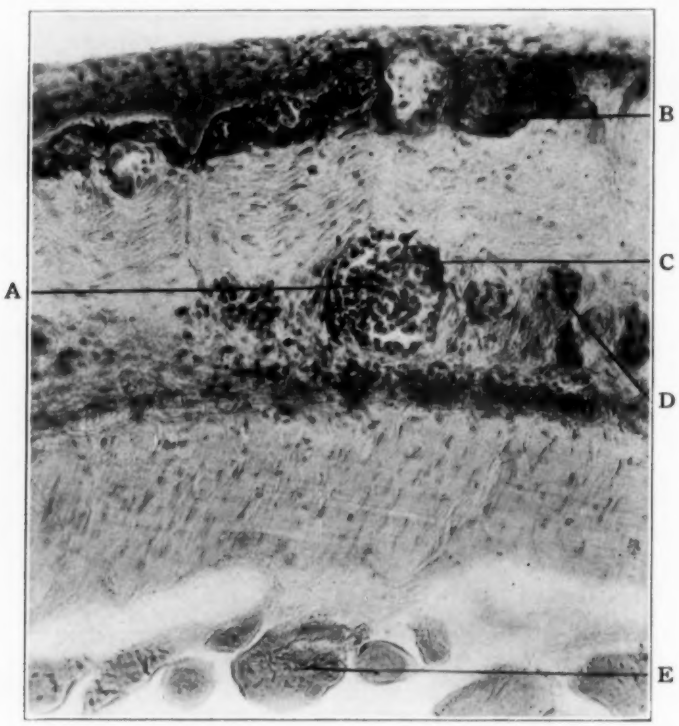

Fig. 3.—The stage of contraction, after radium has been applied for forty-eight hours. Changes in the muscles are notable as well as changes in the endothelium. *A* indicates leukocytes; *B*, beginning thrombosis; *C*, a constricted vessel; *D*, vessels occluded by edema, and *E*, cloudy swelling of the muscle.

dles are undergoing cloudy swelling, and the deeper structures are definitely injured at this stage. Later an even more marked change occurs (fig. 5). The vessels are contracted, the lumens are filled with leukocytes, and the walls show degeneration. The vessel beneath the skin has ruptured owing to injury and necrosis of the wall. Other vessels show edema of the lumen, and still other vessels show beginning thrombosis with edema and injury of the endothelium. The subepi-

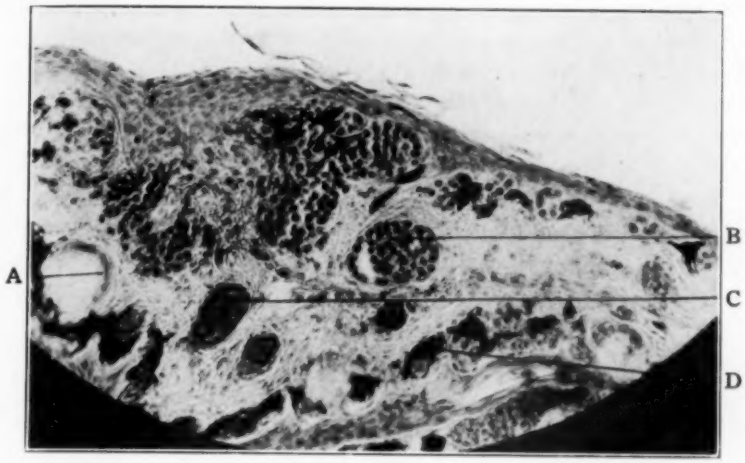

Fig. 4.—Beginning necrosis of the deeper structure. *A* indicates edema of endothelial cells; *B*, leukocytes; *C*, more marked contraction of the vessels, and *D*, thrombosed vessels.

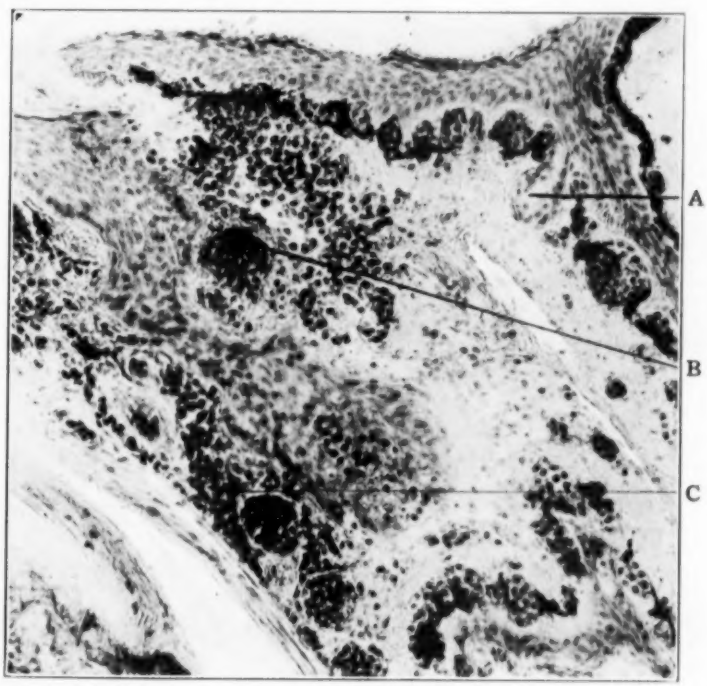

Fig. 5.—Necrosis taking place in the deeper structures which in time will lead to sloughing of the tissue and scar formation. *A* indicates edema of the endothelial cells; *B*, a thrombosed vessel, and *C*, leukocytes.

thelial fibrous tissue is practically gone, and throughout the section are seen fibrous tissue strands invading the underlying stroma. The final stage in the acute condition is shown in figure 6. The nuclei of the epithelial cells are paler, and the cells are more widely spaced, showing cloudy swelling and beginning necrosis. The subepithelial fibrous tissue has undergone hyaline degeneration. The vessels beneath this fibrous layer have for the most part become thrombosed, while a few show edema of the endothelial cells. There has been a migration of the leukocytes to the surrounding tissue and rupture of the walls of the vessels owing to degeneration within the walls themselves. The fibrous tissue

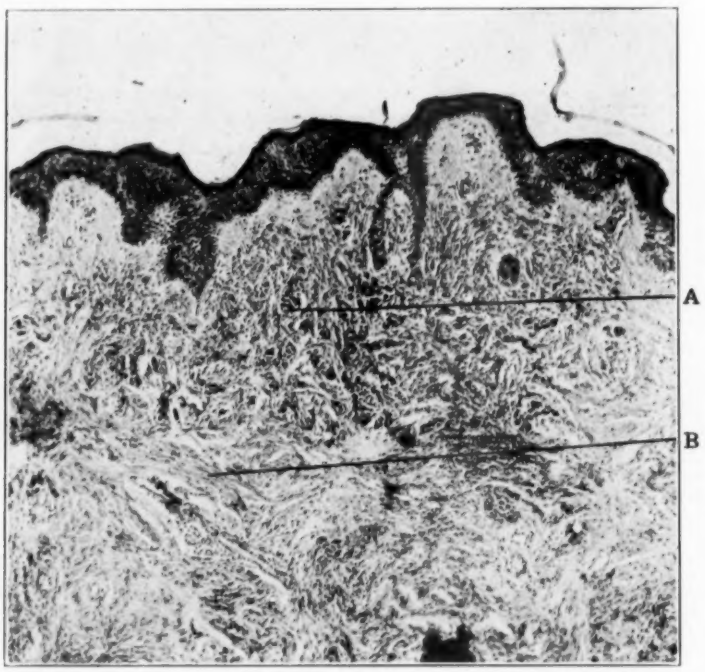

Fig. 6.—A section of a scar removed six months after a burn by radium. Note the beginning of new vessels (*A*) and the amount of fibrous tissue (*B*).

is pale-staining and shows edema of the fibers as well as paleness and degeneration of the nuclei. Deeper, for the first time, one sees changes taking place in the subcutaneous tissues. The deeper tissues show changes similar to those in the subepithelial structures, yet there is a greater reaction; more leukocytes are noted and the tissues undergo degeneration to a greater extent because of the loss of blood supply.

Figure 7 shows the changes that have taken place in the skin and subcutaneous tissue six months following a radium burn. The epithelium is thin, grossly smooth, shiny and hairless, and there is a minimum

of sweat glands. Beneath this layer of epithelium is a layer of hyaline tissue produced by degeneration of the fibrous tissue In the subcutaneous tissue are many newly formed blood vessels, yet on the whole these are few and grossly the scar is pale and ischemic. There is no definite arrangement of the fibrous layer, yet no muscle tissue is seen, showing a complete degeneration of this tissue following the burn. The fibrous tissue for the most part is nonelastic; owing to the contraction the scar is given a tense appearance and seems to be stretched over the underlying normal tissue.

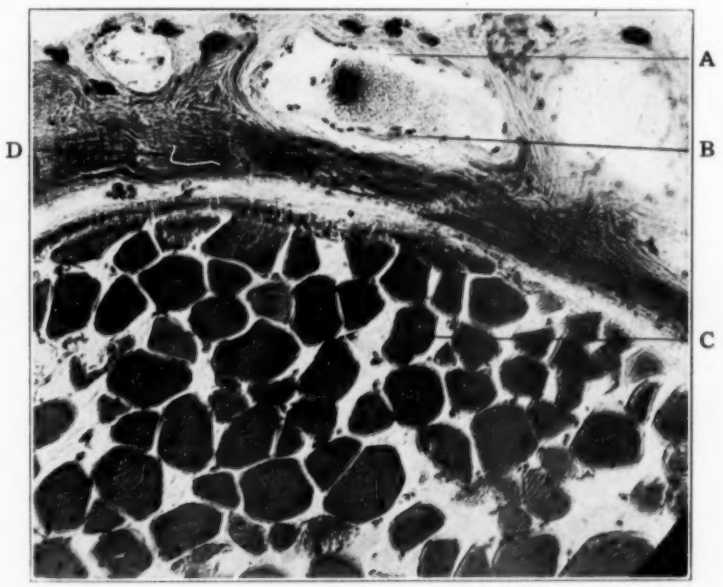

Fig. 7.—Normal tissue, showing a blood vessel (*A*), the endothelial lining of the blood vessel (*B*) and muscle tissue (*C*). A normal amount of fibrous tissue (*D*) is seen in this section.

From the gradual changes seen in the first figures one would not suppose that degeneration of so marked an extent could take place following such a burn. However, from the condition in the tissue, consisting of thrombosis and degeneration of the fibrous tissue and even of the muscle, it is easy to see how sloughing would take place. It is not the extent of injury to the tissues that limits the extent of the sloughing but the degree of injury to the blood vessels. Therefore, the tissue on section may appear normal, but if there has been injury to the walls of the vessels to the extent of causing edema of the endo-

thelium, then thrombosis is likely to take place and degeneration of the tissue soon follows owing to the lack of blood supply. Thus it may be seen that one cannot judge to the full extent the degree of burn or of damage to the tissues by the immediate reaction of the area exposed to the radium. Often a burn heals, breaks down, heals and after a long period of time breaks down again. This is due to the injury of the vessels which at the time are able to carry blood and supply the tissue to some extent. Later these vessels become thrombosed, and the blood supply is thus cut off.

SUMMARY

The stages of radium burn may be classified as:

1. The stage of engorgement. This is early and is the stage of slight erythematous swelling and subsequent complete recovery of the tissues.

2. The stage of constriction. This leads to injury to the tissues; although no scar results the tissues are definitely injured.

3. The stage of necrosis. Following the slough there is scar formation with atrophy of the tissues and permanent damage to the underlying structures with a possibility of trouble at a later date.

One should plan the amount of radium to be used, the nature of the condition and the result desired, so that at some later date changes may not take place that are not expected and that lead to further trouble for the patient and the physician.

SPONTANEOUS PNEUMOTHORAX COINCIDENT WITH ESOPHAGOSCOPY

REPORT OF TWO CASES

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The term spontaneous pneumothorax means the presence of air in the pleural cavity and is descriptive of the type of pneumothorax which occurs in apparently normal persons. This condition is also called idiopathic pneumothorax, but this implies pneumothorax without any known cause, while a cause can be attributed in many cases of spontaneous pneumothorax. It excludes cases due to artificial means, such as direct trauma, and to ulcerative communication between the alimentary tract and the pleural spaces.

This condition is very rare and is usually associated with fluid exudate of some sort, such as serum (hydropneumothorax), pus (pyopneumothorax) or even blood (hemopneumothorax).

There are three types of spontaneous pneumothorax: the open, in which the rent in the surface of the lung remains patulous; the closed, in which the rent is healed or held in position by the positive pressure of the air in the pleural cavity, and the valvular, which allows air to enter the thorax on inspiration, but does not allow it to escape on expiration.

Spontaneous pneumothorax may be single, affecting only one lung; double, affecting first one lung and then the other, or simultaneously double, affecting both lungs at the same time. It may be recurrent, occurring again in one lung only, or alternate, occuring first in one lung and then in the other.

Emerson,[1] in reviewing the history of pneumothorax, stated that this disease has been known since the days of Hippocrates (500 B. C.), but at that time it was known only as empyema. In 1803 Itard, at autopsy, demonstrated pus and air in the pleural cavity and gave it the name of pneumothorax. In 1819 Laënnec claimed that he was the first to recognize pneumothorax during life and gave an accurate and full account of this condition, based principally on examination with the stethoscope, which he invented.

Candidate's thesis read by title before the American Laryngological, Rhinological and Otological Society, Inc., April 3, 1934.

1. Emerson, C. P.: Pneumothorax: An Historical, Clinical and Experimental Study, Johns Hopkins Hosp. Rep. **11**:1, 1903.

PHYSIOLOGY

Normally the lungs completely fill the chest and are held in the expanded condition on account of the negative pressure in the pleural sac, so that the pleural sac exists only potentially. According to some authors, the negative pressure on expiration is —5 mm. of mercury; and on inspiration, —10 mm.

The mediastinum in the normal subject is a mobile structure held in position by the traction of the elastic tissue of the lungs, which exerts a pull in opposite directions. If there is open pneumothorax on one side the lung on that side collapses and its elastic recoil is satisfied, while the elastic recoil on the sound side is partially satisfied by the displacement of the mediastinum toward that side. With no adhesions and suddent collapse, the respiratory excursions of the mediastinum and the change in the intrathoracic pressure combine to interfere with the normal circulation and add greatly to the severity of the symptoms.

Negative pressure is necessary during the act of inspiration, in order that air may be drawn down through the trachea to fill the lungs. During inspiration the volume of the thorax increases, while during expiration it decreases.

Lilienthal and Amberson [2] showed that if the wall of the chest is closed and there is no opening on the surface of the collapsed lung, as is seen in artificially produced pneumothorax, the mediastinum moves with ordinary respiration. The pressure of the imprisoned air increases on forced expiration and displaces the mediastinum toward the healthy lung. On deep inspiration it seems to remain in the midline. Frequently the compressed lung is forced into the retrosternal space. Rotation of the heart is less marked in pneumothorax on the left side than in that on the right side. In the valvular type of pneumothorax air easily escapes from the lung into the pleural cavity on inspiration but does not escape so easily from the pleural cavity back into the lung on expiration. The mediastinal septum is pushed over to the healthy side; the air pressure is raised, and the diaphragm is depressed, because the negative pressure by which these organs are partly retained in their ordinary position has been relieved.

Fluid, gas and tumors in the pleural sac disturb the intrapleural pressure in different ways. Air presses in all directions; fluid presses principally at the bottom of the pleural sac, while tumors cause local pressure.

ETIOLOGY

In some cases of pneumothorax no cause can be found, the patient being apparently well. In other cases the condition follows extreme

2. Lilienthal, Howard, and Amberson, J. B., Jr.: Unilateral Pneumothorax, Arch. Surg. **18**:533 (Jan., pt. 1) 1929.

exertion. In some cases it occurs without having any apparent influence. There is no doubt that many patients have this condition who have never consulted a physician, and undoubtedly many cases have gone unrecognized, especially before the days of the roentgen rays. These are cases of the idiopathic or spontaneous type.

According to John Lovett Morse,[3] pneumothorax in early life is more often due to perforation of the lung with an aspirating needle, or trocar, than to all other causes combined, and is seldom due to the rupture of a caseous tubercle.

Browder [4] asserted that spontaneous pneumothorax in the form of pyopneumothorax resulting from a ruptured subpleural abscess requires simultaneous rupture of the abscess into a bronchiole and through the visceral pleura, in order that air may gain entrance into the general pleural cavity.

Among the causes are tuberculosis, empyema, bronchial fistula, emphysema, emphysematous blebs, vesicular blebs, abscess of the lung, pneumonia, lymphosarcoma, necrosis of the lung, bronchiectasis, gangrene, pulmonary thrombosis, tear due to adhesions, senile atrophy, asthma, pertussis, diphtheria, foreign body in the lung, typhoid, hydatid and influenzal bronchitis. Tuberculosis is the cause in by far the greatest majority of cases.

Hamman [5] stated that pneumothorax is always a secondary disease of the lung or wall of the chest and therefore is a complication.

Pathologists have drawn attention to the fact that tubercles are early deposited just beneath the pleura. There is no doubt that emphysematous blebs are a frequent cause of spontaneous pneumothorax, while adhesions have often been the cause of a tear of the pleural surface. General pneumothorax can be found only before adhesions have formed; otherwise the collapse can be only partial, depending on the amount and strength of the adhesions present. The most common cause of pleural adhesion is tuberculosis. Pulmonary adhesions are considered a protective process against perforation. Heredity does not seem to play a part in this disease. There is only one instance on record, reported by Atwood,[6] in which it occurred in father and son, but this might be due to any one of several causes.

Vigorous and prolonged attempts at artificial respiration may give rise to pneumothorax and subcutaneous emphysema.

3. Morse, J. L.: Clinical Pediatrics, Philadelphia, W. B. Saunders Company, 1926, p. 547.

4. Browder, Jefferson: Spontaneous Nontuberculous Pneumothorax, Am. J. Surg. **7**:415, 1929.

5. Hamman, Louis: Spontaneous Pneumothorax, Am. J. M. Sc. **151**:229, 1916.

6. Atwood, A. W.: Spontaneous Pneumothorax, Boston M. & S. J. **195**:1237, 1926.

According to Kahn, a small pneumothorax cavity containing from 200 to 500 cc. of air is practically undetectable by physical examination, and one containing from 200 to 250 cc. cannot be detected even by the roentgen rays.

SYMPTOMS

Pain and dyspnea are usually the first symptoms that the patient complains of, although in some cases the disease comes on insidiously and the patient has no complaint. The succussion splash may be the first symptom noted by the patient. Usually he has an anxious look, is pale and breathes with difficulty; these signs are sometimes accompanied by cough and dizziness. The degree of dyspnea resulting from collapse of the lung depends on the functioning ability of the sound lung. It has been shown experimentally that an animal at rest can breathe with one tenth of the surface of the lung functioning without experiencing dyspnea. The pain that the patient experiences is due to laceration of the pleura, while the cough is due to irritation of the pleura and is usually unproductive.

Pain is usually felt over the front of the chest, radiating to the shoulder and occasionally down the arm, simulating the pain in angina pectoris. It also may be mistaken for neuritis, and if it is on the right side it may be mistaken for the pain in disturbance of the gallbladder. Occasionally the pain is in the back beneath the scapula. In a few cases there are abdominal symptoms at the onset. Sometimes the rupture may be felt, or even heard, by the patient.

PHYSICAL SIGNS

If the pneumothorax is of the open type, there is little enlargement of the affected side; if it is of the closed type, the affected side is considerably enlarged. The heart is always displaced. The percussion note is tympanitic in the open type of pneumothorax and exaggerated vesicular in the closed type. There are generally no râles. The patient is usually found lying on the nonaffected side but occasionally is found lying on the affected side; in only one case reported in literature was a patient comfortable lying prone. Nearly all the patients lie partially sitting up. On palpation the heart beat is usually displaced to one side or the other. Fremitus is greatly diminished and sometimes abolished; sometimes it is increased in front, probably due to bands of adhesions or to pressure of a portion of the lung against the wall of the chest.

On percussion there may be a hyperresonant sound like that in emphysema, or the sound may be of a tympanitic or amphoric quality, while again it may be dull. These variations depend on the intrapleural tension. The sound may be even muffled, toneless or almost dull. Of course there is dulness at the lower part of the chest when fluid is present. The hippocratic succussion splash may be heard while the

patient's body is shaken. Sometimes this splashing sound may be heard across the room, and even the patient himself may notice it. The metallic phenomena are best heard in cases in which there is a consolidation of the lung with thickened pleura, as in tuberculosis. On percussion the heart is found pushed over to one side or the other, and the liver may be displaced even below the margin of the ribs. If fluid is present there is usually dulness at the base of the lung, and it can be made to change by altering the position of the patient. The flatness of the liver may be obliterated. Tactile fremitus is absent or greatly diminished.

Auscultation shows absence of or great diminution in the intensity of the breath sounds, while the voice sounds are not so much diminished. The variations are greater on auscultation than on percussion. Respiratory sounds may be absent, but if present may be amphoric. Vocal fremitus has the same quality as the breath sounds and may even bring out the amphoric quality more clearly. A short cough sometimes brings out this quality when it is not heard otherwise, and there may be the metallic tinkle. There may be a gurgle on inspiration. The coin sound is characteristic and used to be considered pathognomonic of pneumothorax, but Pepper, in 1895, drew attention to the fact that it was often heard in cases of large tuberculous cavities with a free opening into a bronchus.

In double pneumothorax all these symptoms and signs may be present and thus cause confusion.

In addition to the effects of pneumothorax on respiration, there are effects on the circulation.

DIAGNOSIS

Loving [7] stated that while the valvular type of spontaneous pneumothorax eventually becomes the closed type, differential diagnosis has to be made between open and closed pneumothorax. In open pneumothorax the opening is large, and air passes in both directions; the intrapleural pressure is zero; collapse is rapid, and compensation is poor. There is severe dyspnea or asphyxia; the chest is tympanitic; the coin sound is present; cough and the breath sounds are amphoric, and there is also pectoriloquy. The lung usually remains collapsed. In closed pneumothorax the opening in the lung is small and valvelike; air passes from the lung to the chest only; the intrapleural pressure is positive; collapse is gradual, and compensation is good. Symptoms may be moderate, slight or lacking; there is no tympany; the coin sound is not heard; the heart and breath sounds are diminished or absent, and the chest is noticeably silent. The lung is usually restored to normal.

Massive collapse of the lung simulates spontaneous collapse. Diaphragmatic or congenital hernia may closely simulate it. Pneumothorax

7. Loving, R. S.: Spontaneous Pneumothorax, Mil. Surgeon **64**:533, 1929.

in a patient with emphysema may cause difficulty. Very large cavities with tympanitic resonance on percussion and râles of an amphoric metallic quality may simulate pneumothorax. In total excavation of one lung the amphoric and metallic phenomena may be intense, but the absence of dislocation of the organs and of the succussion splash may help to differentiate this condition. The coin sound may be heard over a large cavity communicating with the outside air, sometimes in the upper lobe of the right lung.

On roentgen examination the characteristic features are an abnormally clear zone without the normal markings of the lung. The shadow of the collapsed lung is not always easy to see, but the visceral displacements are noticeable. The fluid shows as an opaque shadow, changing with the position of the patient; it is also seen as wavy lines on shaking the patient. Sometimes the level of the fluid ascends at each inspiration, while the diaphragm on the opposite side descends. This was first observed by Kienboeck in 1898, who called it the paradoxical movement; it is better known as the Kienboeck phenomenon. Pneumothorax, open, closed or of the check-valve variety, may be partial or complete, unilocular or multilocular, simple or complicated and unilateral or bilateral.

PROGNOSIS

The prognosis depends largely on the cause. Patients with tuberculosis may die within a few weeks. In some cases of tuberculosis in which pneumothorax occurs the latter seems to arrest the progress of the disease. Open pneumothorax may persist for years. In ordinary idiopathic or spontaneous pneumothorax the prognosis is good. Cases due to a ruptured bleb or tear that years later were followed by tuberculosis have been reported.

Clinically, there are two types: the rapidly fatal and the nonfatal. In the former death occurs within a few hours, while in the latter the course is gradual improvement, the air absorbing within five or six weeks. Recovery may occur within from twelve to fifteen days. The outcome depends entirely on whether or not there are any complications, such as hydropneumothorax, pyopneumothorax and other conditions. Spontaneous double pneumothorax is not always fatal.

The duration of the disease depends on the underlying condition and the presence or absence of infection. In cases in which it is believed to have resulted from rupture of a small subpleural tubercle or emphysematous bleb or tearing of a small adhesion, it usually clears up within from two weeks to two months. The duration may be indefinite, and at least one case has been reported in which the condition was permanent.

LeWald[8] made the statement that in cases of spontaneous pneumothorax, either unilateral or bilateral, it is not safe to infer that complete

8. LeWald, L. T.: Bilateral and Unilateral Nontuberculous Spontaneous Pneumothorax, Arch. Surg. **12**:440 (Jan., pt. 2) 1926.

expansion of one or both lungs will result. In one case reported by him the lung failed to expand for more than a year, and in another, for a period of more than six years. On the other hand, there are usually rapid expansion of the lung and complete restoration of the chest to its normal condition.

TREATMENT

The patient should be kept as quiet as possible and should be warned to suppress cough and to avoid deep inspiration; morphine should be given, if necessary. Sedatives may be necessary to help suppress the cough, and it may also be necessary to strap the chest.

If fluid is present, it may be advisable to remove some of it, if there are pressure symptoms; but if there are not, it is better to let it alone. In severe cases with displacement of the heart, accompanied by cyanosis and low blood pressure, it may be necessary to make a permanent opening in the pleura. A patient with tuberculosis is usually best let alone if he is doing well. When pus is present and the patient is not doing well, aspiration should be done, and it may be necessary to do a thoracotomy and drain the pleural cavity. Later, blowing into bottles may help to reexpand the lung.

Graham [9] drew attention to the fact that in order to prevent fatal asphyxia it is necessary to get enough air into the lungs to satisfy the tidal air requirements. The tidal air requirements ordinarily constitute only from one eighth to one twelfth of the total amount of air which can be inhaled on the deepest inspiration. The latter is known as the vital capacity. Patients with a high vital capacity can stand a greater amount of air in closed pneumothorax than those with a lower capacity.

REPORT OF CASES

Case 1.—A. M., a married woman 23 years old, was first seen on Nov. 28, 1932, because of a severe pain in the chest along the right border of the sternum and difficulty in swallowing. The family history and the past history were irrelevant. Her illness began with pain in the right substernal region one month before examination; this lasted only a day or two. One week before she was first seen the pain recurred, but was "relieved" by sodium bicarbonate. Three days later the pain returned and continued constantly for four days, except when she was lying down. Examination showed that the eyes were normal. There was atrophic rhinitis. The thyroid was not enlarged. The lungs were apparently normal, and the heart, blood pressure and abdomen were normal. The reflexes were normal. The Wassermann reaction was negative. Fluoroscopic study of the esophagus by means of a barium meal disclosed the swallowing function to be normal and showed no evidence of a foreign body. This examination was made in the right oblique diameter only. The roentgenologist deemed it unnecessary to take a roentgenogram, and the patient was referred to the bronchoscopic clinic for diagnosis. She

9. Graham, E. A.: Alterations of Intrapleural Pressure and Their Significance, Medicine **3**:417, 1924.

was seen the same day. She complained of fulness in the chest and said that she felt a lump in the esophagus which did not move; this feeling came on after eating; she took sodium bicarbonate, but this did not seem to influence it. She never was nauseated and said that food passed through the esophagus, but gave her a queer feeling, as though it passed an obstruction far down in the chest. There was no bloody expectoration. The patient was given 0.65 Gm. of bismuth three times a day and told to return within a few days if she was no better.

Four days later she returned to my office complaining that she felt no better, and was told to report to the bronchoscopic clinic for esophagoscopy the next morning.

Esophagoscopy was preceded by the administration of 0.008 Gm. of morphine, and cocaine was applied to the back of the throat. The esophagoscope was passed

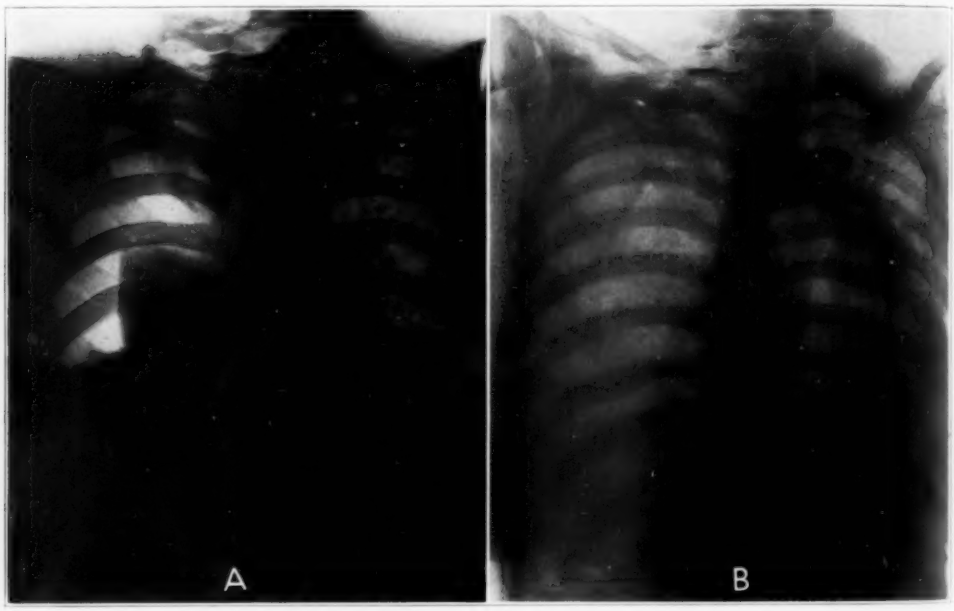

Fig. 1 (case 1).—*A*, roentgenogram taken on Dec. 4, 1932, with the patient in an upright position, showing complete collapse of the right lung and free fluid. *B*, roentgenogram taken on December 8, with the patient in a recumbent position. The mediastinum is markedly displaced to the left, and fluid and air are present in the right side of the chest.

easily, but the direction of the upper half of the esophagus was markedly toward the right, while the lower half deviated toward the left. The center of the esophagus was pulled toward the right at least 1 inch (2.54 cm.) from the midline. As fluoroscopy was done only in the right oblique diameter it is plain to be seen how the curvature of the esophagus could be overlooked. The entire esophagus was explored, and the mucous membrane was found to be normal; there were no dilatations or strictures, and no foreign body was found. There was no evidence of blood on introduction or withdrawal of the esophagoscope, although it was introduced as far as the corona. There was no vomiting, either before or after

esophagoscopy, and no blood was found in the stools. The time consumed in the endoscopy was six minutes, and there was no struggle during the operation.

Immediately following this procedure the patient sat up on the table and admitted that it was not painful. She walked out of the operating room to the recovery room, apparently in good condition, but a short time later complained of sharp pains anteriorly beneath the lower costal margin on the right. The abdominal muscles were tense; the temperature was normal, and there was no dyspnea or shock. After a rest of two or three hours she went home. The pain continued throughout the afternoon, and that evening her physician was called and found her suffering from pain through the chest and difficulty in breathing. The next morning her condition was worse, and she returned to the hospital. Examination showed the chest to be tympanitic, with all the signs of spontaneous pneumothorax, which was confirmed by a roentgenogram.

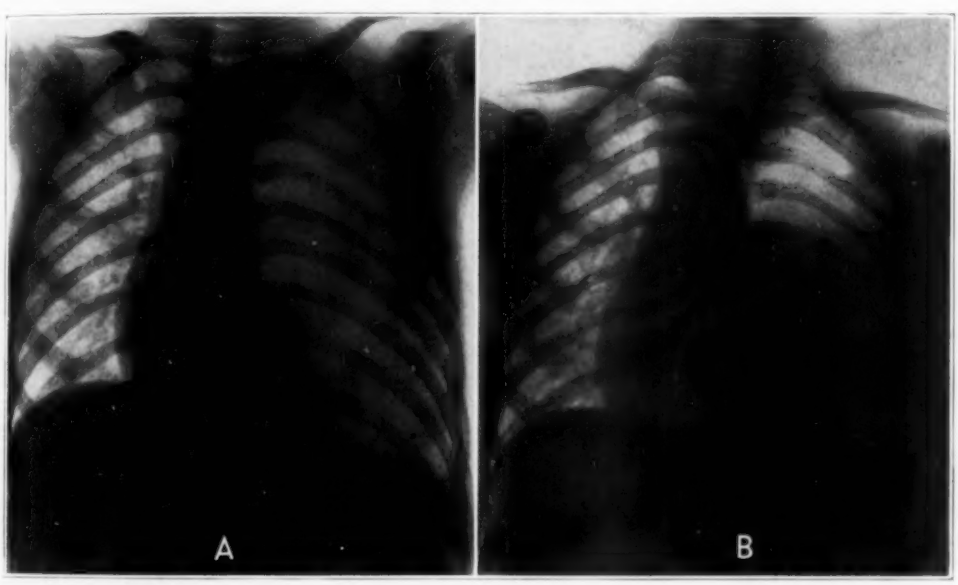

Fig. 2 (case 2).—*A*, roentgenogram taken on June 21, 1933, with the patient in a recumbent position. The mediastinum is displaced to the right, and there is increased density in the left lung, due to fluid and air. *B*, roentgenogram taken on June 22, with the patient in an upright position. Demonstrable pneumothorax, with collapsed lung and free fluid, is present. The mediastinum is displaced to the right.

The day following admission, on account of dyspnea, a needle was inserted through the second interspace, and 275 cc. of air was withdrawn. A second puncture was made through the sixth interspace at the midaxillary line, and a small quantity of clear serosanguineous fluid was withdrawn, sent to the laboratory and injected into a guinea-pig. The reaction was negative for tuberculosis.

Pyopneumothorax rapidly developed, and the patient died on the sixth day after endoscopy. Permission for autopsy was refused.

The diagnosis was spontaneous pneumothorax produced by rupture of a pleural adhesion that had pulled the esophagus to the right side.

CASE 2.—F. C., a boy 9 years old, was first seen at the bronchoscopic clinic on June 17, 1933. Three days before he had swallowed a quarter.

Fluoroscopy showed the coin in the stomach. The mother was anxious to have the coin removed, fearing that it might not pass out of the stomach. Instead of waiting a week or more to see whether the coin would pass, as I should have done, I consented to attempt its removal by the esophagoscope. This was poor judgment on my part, as the coin was causing no symptoms. The endoscope passed easily, but the child struggled terrifically, although he was firmly held down on the table and was not allowed to move. Under the guidance of the fluoroscope the abdomen was manipulated to push the coin up into the axis of the esophagoscope, but this failed, and the esophagoscope was slowly and carefully withdrawn. No sign of blood was seen during this procedure.

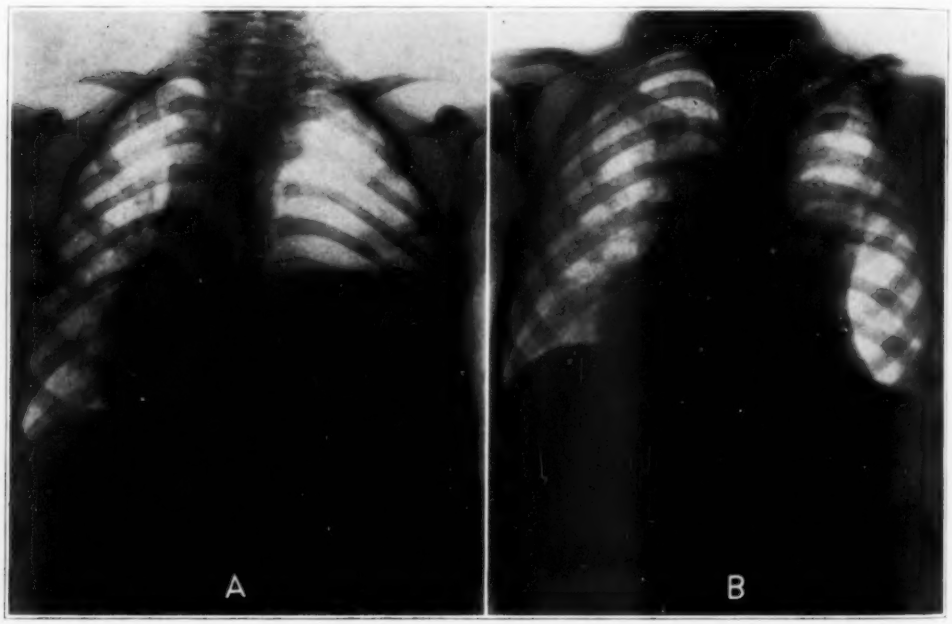

Fig. 3 (case 2).—*A*, roentgenogram taken on June 29. There is a slight increase in the amount of fluid, and the mediastinum is more markedly displaced. *B*, roentgenogram taken on July 20, after thoracotomy, showing very little, if any, free fluid on the left side. The mediastinum is still displaced to the right. The left lung presents incomplete collapse. A considerable amount of air persists in the left side of the thorax.

The patient was then admitted to the hospital suffering with considerable pain in the region of the epigastrium. About three hours later he had nausea and vomited a small amount of clear watery fluid with no trace of blood. Two hours later he vomited about 120 cc. of fluid with brownish streaks in it, and again two hours later about the same quantity of the same appearance; this looked like what one sees in reversed peristalsis. In neither vomitus did the streaks look like blood, but unfortunately this was not verified at the laboratory. Four surgical nurses reported on this. He had two succeeding vomitings in which the vomitus was

about the same quantity and was greenish. No blood was found in the stools at any time.

The following day the rectal temperature was 102.2 F. and the pulse rate 100, with respirations varying from 22 to 32. After the administration of atropine the epigastric distress was not so evident. On the third day the patient had severe pain throughout the left side of the chest and no nausea. On the fourth day he had no disorder of any kind; the temperature was 100 F., and the respiratory rate, 22. On the fifth day a roentgenogram taken with the patient in the recumbent position showed diffuse and increased density throughout the left lung, but as the ribs were fairly well marked it was thought to be fluid, accompanied by air. The physical signs of pneumothorax were pronounced. On the sixth day a roentgenogram taken with the patient in the upright position showed pneumothorax, collapsed lung, free fluid and displacement of the mediastinal structures to the right.

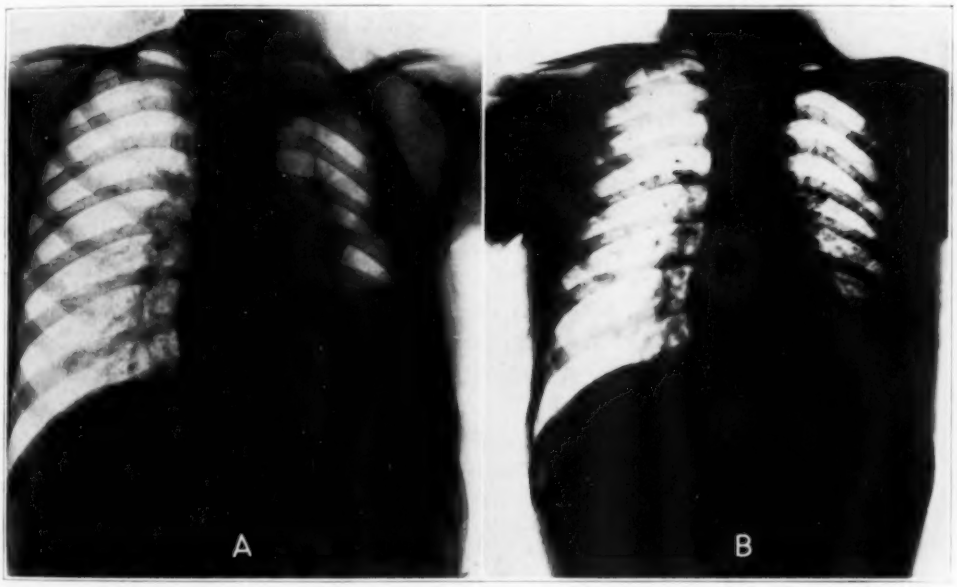

Fig. 4 (case 2).—*A*, roentgenogram taken on August 11, showing free fluid and air remaining in the left side of the chest. *B*, roentgenogram taken on November 2, showing the chest practically clear.

The patient did not complain much during the first ten days, but on the eleventh day, on account of irritability and severe weakness, thoracentesis was done, and foul-smelling pus was aspirated. At this time his temperature rose to 104 F.; it gradually receded the next day. On the sixteenth day resection of ribs was done and drainage instituted. The patient finally recovered.

The diagnosis was spontaneous pneumothorax coincident with esophagoscopy.

CONCLUSIONS AND COMMENT

In case 1 it seems probable from the history and the endoscopic findings that a ruptured pleural adhesion causing an opening in the visceral pleura was the cause of the pneumothorax.

The reason that the curvature of the esophagus to the right was overlooked by the roentgenologist is that he did fluoroscopy only in the right oblique diameter, and therefore the esophagus appeared in a straight line.

In case 2 the pneumothorax might have been due to rupture of the visceral pleura from an emphysematous bleb, a caseous tubercle or some other factor, caused by his intense straining; or was it due to trauma of the esophageal wall? In either event there must have been a ball-valve opening allowing air to pass into the pleural cavity on inspiration and not allowing it to go out on expiration. It is hardly conceivable that air could be passed into a pneumothorax cavity through an opening caused by trauma by positive pressure of air in the esophagus. The air pressure must have been high in the pleural cavity to have pushed the mediastinal structures toward the well side. One must remember that there was also pressure on the mediastinal septum exerted by the fluid in the thoracic cavity. It is easy to see how a ball-valve opening on the surface of the lung could be formed, with collapse and crowding together of the pulmonary tissue. On the other hand, it is hard to understand how this could take place in the mediastinal wall when it is stretched.

Anatomists state that the esophagus is in contact with the pleura on the left side in the cervical region and also on the lower end just before it enters the stomach, while on the right side it is in close contact in the middle section. If the rupture was in any one of these places it must have involved both the pleura and the esophageal wall. If it involved only the esophageal wall one would expect the line of cleavage to give way and air and fluid to dissect out into the mediastinum. This is analogous to subcutaneous emphysema that frequently results from a needle puncture for artificial pneumothorax, with tearing of the visceral pleura and collapse of the lung. If the opening was in any other part of the esophagus where there was not such intimate contact between the surfaces, there would be infection and air in the mediastinum. Mediastinal emphysema usually dissects up along the trachea and appears in the neck. This was not seen in either of these cases.

I have been told by bacteriologists that gas-producing germs could not generate gas fast enough to account for the great amount of air that was seen in these two cases in such a short time. Roentgenologists state that it is difficult to diagnose mediastinitis unless in a severe case, and then the bulging is principally in the middle of the mediastinum. Neither of these patients showed that condition. It seems easier, therefore, to assume that the spontaneous pneumothorax in case 2 was due to rupture of the visceral pleura rather than trauma of the mediastinal septum.

I was unable to find in the literature any report of a case of spontaneous pneumothorax coincident with esophagoscopy.

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THE IMMUNOLOGIC ASPECT OF ELECTROSURGERY IN RHINOLARYNGOLOGY

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In 1932 I [1] described a reaction, specific in nature, which occurs with each electrosurgical treatment of an infected focus. Subsequent observations have brought to light a rational explanation for the "immunity reaction" which follows electrocoagulation. In order that a scientific appraisal of this so-called "autogenous vaccine reaction" may be made, an analysis of the reaction in 100 patients on whom electrosurgical tonsillectomy was performed has been undertaken.

The throat of each patient was swabbed and the predominant organism isolated by smear and culture at the initial treatment. A measured dose of electrocoagulation, desiccation and fulguration was given each patient at each weekly sitting. The time at which the reaction occurred, its duration, type and severity, whether local or general in scope, were noted and recorded in each case.

It has been apparent for some time that patients responded with a marked degree of variation in the intensity of their reaction, both local and general, to the standardized electrosurgical treatment of each tonsil. At first, it appeared cursorily that an idiosyncrasy of each patient was sufficient to account for this variation. Empirical observation, followed by systematic analysis, revealed a definite causative factor for the immunologic response to surgical diathermy.

Many investigators have noted the end-results of tonsillectomy in childhood and adolescence. The work of Kaiser,[2] lately corroborated by Cunningham [3] and by Glover and Wilson,[4] stands out as a beacon to a more scientific interpretation of the effects of tonsillectomy and adenoidectomy. Their observations show that the condition of the tonsils is of minor importance in the history of the health of the patient and in the determination of physical measurements; that the contention

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1. Silvers, Lewis J.: Electrosurgery in Rhinolaryngology: A Solution for the Tonsil, Turbinate and Sinus Problems, Arch. Phys. Therapy **13**:154 (March) 1932.

2. Kaiser, A. D.: The Relation of Tonsils and Adenoids to Infections in Children, Am. J. Dis. Child. **41**:568 (March) 1931.

3. Cunningham, Ruby L.: Normal, Absent and Pathologic Tonsils in Young Women: A Comparison of Physical Measurements, Arch. Int. Med. **49**:453 (March) 1932.

4. Glover, J. A., and Wilson, Joyce: End Results of Tonsil and Adenoid Operations in Childhood and Adolescence, Brit. M. J. **2**:506 (Sept. 3) 1932.

that normal tonsils are an aid in resisting disease is not strongly defended by contrasting the histories of those with normal and those with pathologic tonsils; that the argument that the removal of tonsils closes the portal of entry for infectious respiratory diseases is not sustained by a comparative study of the histories of those who have had their tonsils removed and those whose tonsils are present. The authors seem to concur on the indications for tonsillectomy in selected cases. They hold no brief for the retention of diseased or really obstructive tonsils or adenoids, nor do they wish to underestimate the value of the operation in cases in which there is evidence of toxic or obstructive damage. The effect of tonsillectomy on the occurrence and course of acute polyarthritis is recorded by Finland, Robey and Heimann [5] in their analysis of the records of 654 consecutive cases. They found that previous

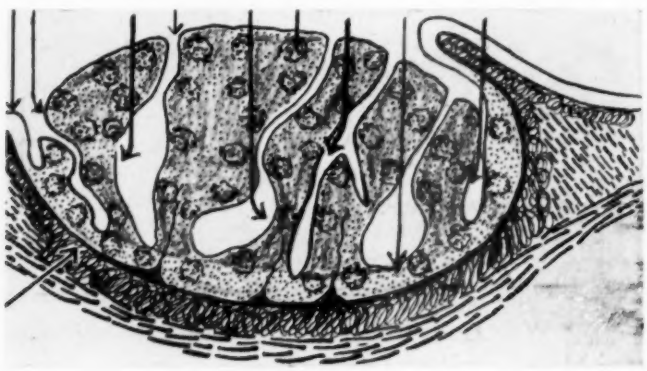

Fig. 1.—Cross-section of a tonsil, a "laboratory" where toxins and antitoxins are in constant formation. Note crypts and fundi.

tonsillectomy had no striking effect in reducing the incidence of cardiac lesions in this series of cases. Approximately one-half of the patients who were operated on while their condition was apparently quiescent showed evidence of activity following the operation, but in only 6 persons were there serious complications. The average number of recurrences in the patients admitted following tonsillectomy was about the same as in those not previously operated on. The attacks, however, were much closer together in those previously tonsillectomized. It becomes apparent, then, that simple removal of an infected focus is not sufficient to alleviate the symptoms or ameliorate the progress of any disease.

5. Finland, M.; Robey, W. H., and Heimann, H.: The Effect of Tonsillectomy on the Occurrence and Course of Acute Polyarthritis, Am. Heart J. **8**:343 (Feb.) 1933.

It has fallen to my observation,[6] in corroboration of the findings of Dan McKenzie,[7] later substantiated by Balmer,[8] that after one has begun electrosurgical extirpation of the tonsils of patients suffering from neuritis, myalgia or arthritis, relief from pain may be quickly afforded. This phenomenon of relief from distal pain following the first few applications of surgical diathermy to the infected tissues is responsible for the present investigation into a field which may prove most fertile in checking the ravages of the more virulent infecting organisms.

Theoretically, many factors may enter into this equation which may give the patient relief from symptoms. McKenzie suggested that sterilization of the focus in the tonsil is responsible for the clearing up of symptoms. This may be refuted on the ground that pain is often relieved before total sterilization of the focus. The point of view was advanced that diathermocryptectomy, by destruction of myriads of bacteria in situ, produces a reaction in the patient analogous to that to autogenous vaccine. Still there remains the possibility that a reaction to nonspecific protein occurs simulating the response to typhoid vaccine or to injections of sterile milk.

The main purpose in surgical intervention in any pathologic process is to eradicate that which is deleterious to the organism and leave undamaged that which is normal and beneficial. By means of electrosurgery the former is readily accomplished in operations on the nose and throat. In addition, an enhancement of the normal function of the remaining uninjured tissue is obtained.

With each electrosurgical treatment myriads of bacteria are destroyed in situ, whether it is in the coagulation of tonsillar tissue in the mouth or in the shrinkage of turbinate tissue in the nose by subcoagulation doses. The ectotoxins and endotoxins set free by these dead bacteria are absorbed via the lymphatics and create a response in the body similar to that to an autogenous vaccine. This reaction like that to autogenous vaccine is, then, the causative factor in the increase in immunity to the specific organism lying dormant, perhaps, in other foci in the body. This immunologic reaction has been observed to be the primary factor in reducing or completely obviating the distal aches and pains.

This immunologic concept of the action of electrosurgery in the treatment of foci of infection is clinically substantiated by the patient

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6. Silvers, Lewis J.: Electrosurgical Extirpation of Tonsils: A Clinical Study of Various Methods Employed with Their End-Results, Arch. Otolaryng. **12**:511 (Oct.) 1930.

7. McKenzie, Dan: Diathermy, Medical and Surgical, in Otolaryngology, New York, The Macmillan Company, 1930.

8. Balmer, Frederick B.: Electrosurgery and the Otolaryngologist, Including Gradual Extirpation of the Tonsils by Electrocoagulation and Diathermocryptectomy, Arch. Otolaryng. **15**:503 (April) 1932.

observing relief from pain either in the joints, muscles or nerve sheaths (arthritis, myositis or neuritis), respectively, long before extirpation of the infecting organisms occurs.

To differentiate the immunity reaction that takes place with electrosurgery from a simple reaction to protein, I have carefully analyzed the reactions of patients to measured doses of electrocoagulation, desiccation and fulguration. The degree of reaction, the time after treatment and the length of reaction, whether general or local, were noted in each case. The response to treatment depended on the virulence of the infecting organism. The more potent the strain of the infecting virus the greater the reaction observed. This eliminates nonspecific protein as the only probable factor.

Sterilization of the focus of infection by diathermic heat generated in the tissue through its resistance to the high frequency current is

TABLE 1.—*Analysis of the Autogenous Vaccine Reactions Following 100 Electrosurgical Tonsillectomies*

Preponderant Organism	Reaction After First Treatment	General Reaction* Noted Up To	Peak of Reaction
Positive, 86; negative, 14			
Hemolytic streptococci, 25.7%	General and local	Fourth treatment	Fourth day
Nonhemolytic streptococci, 16.1%	General and local	Third treatment	Third day
Staphylococci, 20.9%	Local	Rarely any	Second day
Spirilla Vincenti, 4.6%	General and local	Fourth treatment	Fifth day
Diphtheroids, 2.3%	General and local	Third treatment	Second day
Actinomyces, 3.4%	Chiefly local	Fourth treatment	First day
Miscellaneous bacteria, 13%	Local	Third treatment	Second day

* It was rarely that a general reaction was observed after the fourth treatment; the focus was apparently eradicated.

probably responsible for the elimination of some of the toxic products of the highly virulent bacteria. However, a clinical response to treatment occurs long before the focus is entirely extirpated. As a matter of fact, patients note relief from their distal aches and pains soon after the first few electrosurgical treatments and long before the entire focus of infection is eradicated.

Further investigation into this problem reveals other interesting possibilities. In discussing local agents that increase immunity in sinus mucosa, Fenton [9] emphasized the action of the histiocyte, or so-called "reticuloendothelial" cell capable of phagocytosis. Here one learns of the noninfectious factors which may influence pathologic conditions of the nose and throat. Inflammatory changes such as the exfoliation of

9. Fenton, Ralph A.: Local Agents That Increase Tissue Immunity in Sinus Mucosa, J. A. M. A. **99**:2247 (Dec. 31) 1932; Immunity in Otolaryngology, Tr. Am. Laryng., Rhin. & Otol. Soc., 1931, p. 427; "Reticulo-Endothelial Components" of Accessory Sinus Mucosa: Experimental and Clinical Observations, Arch. Otolaryng. **14**:586 (Nov.) 1931.

epithelium, overgrowth of serous glands and edema of the subepithelial tissue are the signal for mobilization of numerous histiocytes and plasma cells. Following these protective elements, which depend on the type of irritation and the duration of the irritative process, polymorphonuclear leukocytes and lymphocytes arrive in increased numbers, and red cells may also be extravasated.

Combiesco and his associates [10] found that the treatment of tonsillar abscesses with antistaphylococcic bacteriophage assures a rapid cure. As the results obtained by the authors with the staphylococcic bacteriophage were uniformly good, no matter what the bacterial flora of the pus, they concluded that these results cannot be due to any specific action of the lytic principle or to its exclusive action. Treatment of the abscesses with antistaphylococcic or antistreptococcic filtrate prepared

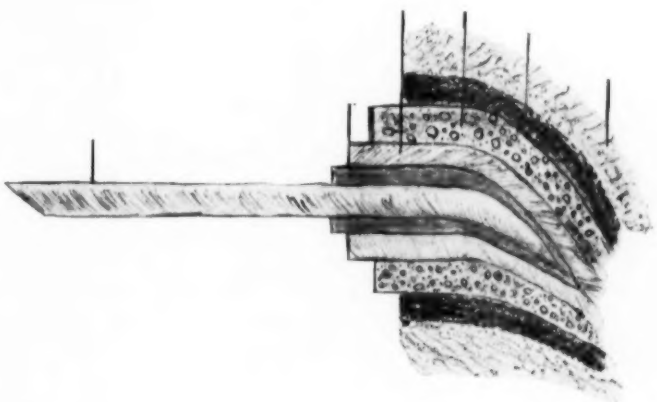

Fig. 2.—Diagrammatic sketch demonstrating the histologic effect of the high frequency current (active needle electrode in action).

according to Besredka's method, as well as with sterile peptone broth and physiologic solution of sodium chloride, gave uniformly the same results. As I have observed similar good results with diathermy, both medical and surgical, I am led to believe that the mechanism of the stimulation of the defense elements of the organism is brought into action.

Dean,[11] analyzing the laboratory investigations as aids in otolaryngologic diagnosis, puts one on one's guard as to the extreme care necessary to differentiate, even by expert cytologic examinations, between the numerous blood diseases localizing in throat manifestations. Just

10. Combiesco, D.; Tzetzu, I., and Popesco, M. S.: Mechanism of Action of Bacteriophage in Treatment of Tonsillar Phlegmons, Presse méd. **40**:1386 (Sept. 10) 1932.

11. Dean, L. W.: Laboratory Investigations as Aids in Otolaryngologic Diagnoses, J. A. M. A. **99**:542 (Aug. 13) 1932.

as one must carefully differentiate between the ordinary lymphatic reactions and the monocytic anginas, such as myeloblastic leukemia and agranulocytosis, so must one cautiously learn to differentiate between the varied reactions due to the absorption of the end-products of various organisms present in the diseased focus in the nose and throat.

RELATION OF TONSILS TO THE THYROID GLAND

For some time it has been noted that the average patient with thyrotoxicosis is markedly improved after removal of the tonsils. However, the opposite effect has recently been reported by experienced oto-

TABLE 2.—*Clinical Analysis of the Untoward Reactions in 1000 Electrosurgical Tonsillectomies*

	Simple Coagulation: Number of Treatments to Each Tonsil		Modified Coagulation Technic: Number of Treatments to Each Tonsil	
	2	4	4	5
Incapacitation	2 days	1 day	None	None
Hemorrhage	4 cases controlled by fulguration	1 case controlled by tincture ferric chloride	1 case of blood dyscrasia controlled by fulguration	None
Dysphagia	6 days	4 days	3½ days	2 days
Edema in adjacent tissues	All cases	Less than half of cases	Half of cases	One sixth of cases
Complications (miscellaneous)	Foul breath, large slough, rarely clean fossae	Foul breath, smaller coagulum, cleaner fossae	Mild foul odor of breath	Transiently foul breath
End-results	Electro-cryptectomy	Electro-sterilization	Fossae ragged	Fossae clean

The table demonstrates the necessity of increasing the number of treatments in the multistage electrosurgical tonsillectomy. The absence of hemorrhage and the comparative comfort of the patient when my modification of the simple coagulation technic is used are evident.

laryngologists. In reporting on tonsillectomy in two cases of thyroid disease, Bullwinkel [12] emphasized the importance of first giving attention to the thyroid disease per se. One patient who prior to operation gave a clinical picture of myxedema, with a metabolic rate of minus 14, proved even more thyroid-toxic than the other, for whom a metabolic rate of plus 30 was recorded. He concluded that it is certainly possible to precipitate an acute thyroid crisis by surgical procedures unless extreme care and thought are exercised. Dr. Luther MacKenzie reported a fatal case [13] of acute thyroiditis which followed surgical tonsillectomy.

12. Bullwinkel, H. G.: Tonsillectomy in the Presence of Thyroid Disease, New York State J. Med. **33**:627 (May 15) 1933.

13. MacKenzie, Luther: Personal communication to Dr. Bullwinkel at the meeting of the American Laryngological, Rhinological and Otological Society in 1931.

This past winter I discussed a case presented at the New York Polyclinic Medical School and Hospital, in which acute thyroiditis complicated electrosurgical tonsillectomy. The presence of infection in the nasopharynx as an etiologic factor in the thyroid disease was discussed. The importance of recognizing the relationship which exists between the thyroid gland and the tonsil was stressed. I noted that the removal of tonsils often became manifest in the clinical picture of hyperthyroidism and hypopituitarism. One is familiar with the accumulation of flabby adipose tissue in the adolescent youngster, particularly the girl, following tonsillectomy. In my own hands, electrosurgical tonsillectomy, practiced with meticulous caution toward the complete extirpation of the tonsils, is indicated in the patient with hyperthyroidism. In the hypopituitary type I have advised subtotal tonsillectomy or diathermocryptectomy as the method of choice.

NEWER SCOPE FOR ELECTROSURGERY

It has been my privilege to observe personally the work of Kernan [14] in the treatment of primary carcinoma of the lung and bronchus by radon implantations and diathermy. Five cases of carcinoma of the lung and bronchus in which treatment was successful are the only ones in which the patient lived more than six months after a positive diagnosis was made. He inferred from his observations that the disease carcinoma may not lie in the tumor which histologically is carcinoma. There must be some metabolic condition that is the real disease of which the tumor is only the local manifestation. The experience of Kernan with primary carcinoma and lymphosarcoma of the tonsil has also been provocative of the question as to whether complete local destruction of the evidence of a disease necessarily means the total eradication of that disease, especially as applies to cancer. A new field is thus presented to the electrosurgeon in otolaryngology.

TYPES OF ANESTHESIA IN ELECTROSURGERY

The problem of anesthesia is most pertinent to this field of work. For complete relaxation in bronchoscopy, ether is still the safest of anesthetics. However, with electrosurgery, combustible gas must be used with extreme caution, as evidenced by the recent experience of capable surgeons. Local cocaine anesthesia following preliminary avertin anesthesia is sufficient in the majority of cases. The use of nitrous oxide gas and oxygen has at times proved dangerous when complete relaxation

14. Kernan, John D.: Carcinoma of the Lung and Bronchus: Treatment with Radon Implantations and Diathermy, Arch. Otolaryng. **17**:457 (April) 1933.

is attempted. Conductive anesthesia, as described by Maillard,[15] is most effective in electrosurgical tonsillectomy. Complete absence of pain is thus made possible at the time of operation. However, the after-pain may be more intense when the operator inadvertently treats the innocuous and highly sensitive pillars and plical folds.

COMMENT AND SUMMARY

Much confusion is still prevalent as to the reaction that occurs following each treatment of the tonsil electrosurgically during the course

Fig. 3.—Demonstration of the transparent mask in use. Complete protection is afforded the surgeon and the patient in all otolaryngologic work.

of total extirpation of the tonsils. An attempt is made to correlate the various types of reaction observed.

A systematic bacterial [illegible]mination of each tonsil reveals a definite relationship between the [illegible]e pronounced griplike reaction and the potency of the invading organism. Allowance being made for extraneous irritation, the amount of treatment at each sitting does not necessarily determine the degree of reaction to be expected. The potency of the

15. Maillard, Edgar R.: Conductive Anesthesia for the Electrosurgical Removal of Tonsils, New York State J. Med. **33**:527 (April 15) 1933.

invading organism is the decisive factor. The more virulent the invading organism, the more pronounced the resultant local and general reactions. The greatest amount of general reaction is noted at the first two treatments. It is rare to note a general reaction after the fourth exposure to electrosurgery. Relief from distal pain and stiffness, when these are present, follows shortly after the first few treatments.

CONCLUSION

This investigation into the problem of the "immunity reaction" that occurs after electrosurgical treatment of the tonsil has the following connotations: A definite variation in the type of this reaction exists. The reaction may be general as well as local. The general reaction is independent of the local response. A general reaction is rare after the fourth treatment to each tonsil, which is a manifestation of the sterilization of the focus of infection. The general reaction simulates the response to inoculation of an autogenous vaccine made with a virulent organism. It is apparently specific. The occurrence of the relief from distal bodily pain and stiffness is independent of the total sterilization of the tonsil.

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INFECTIONS OF THE NECK

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In this article the superficial types of infection, such as furuncles and carbuncles, will not be considered; only the deeper types of infection will be discussed. These I have divided into five classifications. First, there are acute suppurative conditions in the neck secondary to infections elsewhere. Many of these originate in some infection about the mouth, although they may come from infection about the scalp or face and occasionally from more distant points. They may develop by metastasis or by direct extension. The second type is known as woody or ligneous phlegmon, a condition which is probably secondary to infection elsewhere and in which there is marked induration but in which suppuration never occurs. In the third group are infections due to certain specific causes, and in this group are tuberculosis, syphilis, actinomycosis, blastomycosis and a rare condition, tularemia. The fourth group consists of infected cysts and infected tumors of various kinds, such as cystic hygroma, lymphangioma and degenerated malignant lymph nodes. The fifth group includes thyroiditis, which may be of the acute suppurative or nonsuppurative type. Both types are rather rare, and the nonsuppurative type often is not suspected until it is encountered surgically.

I studied an unselected series of 125 cases of suppurative processes in the neck. The types encountered in this group are shown in table 1. There were 103 cases of acute suppurative conditions, 18 of broken-down tuberculous lymph nodes, 2 of infected branchial cysts and also 2 of Bezold abscess. The results of analysis of the group of 103 cases of acute suppurative conditions to determine the etiology are given in table 2. It will be noted that in 46 of the 70 cases in which the cause was stated the infection came from conditions related to the oral cavities, which emphasizes the predominant part that infections of the mouth play as a cause of suppurative processes in the neck. The study revealed an interesting point regarding the length of time required for the evolution of suppurative processes in the neck. The average duration of the disease before these patients came under observation was sixteen days; the average additional period before drainage was established was 6.4 days, making an average of 22.4 days intervening between the onset and drainage.

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As to complications, there were 8 cases in which the abscess repocketed and required further drainage, and 4 in which erysipelas developed. There was 1 case with delayed healing in which the condition may have been actinomycosis as well as 1 case in which the patient's temperature remained elevated after drainage of the neck until a pharyngeal abscess was drained two or three days later. In 1 case a slough developed, which opened into the carotid artery, and ligation was necessary. Cultural studies were not made in this case, so that the exact type of infection present is not known. There was no elevation of temperature when the abscess was drained. The patient did well following this and was

TABLE 1.—*Suppurative Conditions of the Neck in One Hundred and Twenty-Five Cases* *

Acute suppurative conditions	103
Broken-down tuberculous glands	18
Infected branchial cysts	2
Bezold abscess	2

* Actinomycosis excluded.

TABLE 2.—*Etiology of Acute Suppurative Conditions of the Neck in One Hundred and Three Cases* *

Not stated	33
Dental extraction	12
"Cold," "flu," rhinitis	10
Dental sepsis	9
Sore throat, tonsillitis	8
Otitis	5
Infections of the face	4
Oral infections, stomatitis	3
Tonsillectomy	2
Parotitis	2
Retropharyngeal abscess	2
Impetigo	2
Miscellaneous	11

* Actinomycosis excluded.

discharged from the hospital. Fourteen days after drainage bleeding began; at first it was slight, but finally became so severe that it was necessary to ligate the carotid artery, after which recovery was uneventful.

The method used by my associates and me in managing these cases is at variance with that of some other laryngologists. One reads about the surgical treatment in cases of pus in the neck and is supposed to believe that a suppurative process almost anywhere in this region is likely to lead to thrombosis of the veins of the neck, or that such a process may burrow into the mediastinum. Our policy has been to follow a conservative plan of treatment, allowing these abscesses to go on to a stage in which fluctuation can be made out or until it can be determined where

the abscess has become localized, before surgical treatment is instituted. The figures just quoted illustrate the length of time many of these cases can be followed with safety before drainage is established. Beck [1] reported on a series of 24 patients whom he had followed and who were treated by surgical exposure; in this series there was 1 death. In our series of 103 cases previously referred to there was only one death. The patient who died presented evidence of jugular and cavernous sinus thrombosis when he first came under observation. Our experience with this group of cases would seem to justify our position in regard to conservative management.

Early in the disease these patients have a gradually rising temperature, usually with no sharp fluctuations, the temperature increasing each day for a few days and then gradually falling. After the temperature begins to fall fluctuation of the abscess usually can be detected. At this time the patient usually states that he feels better. This is the ideal time for drainage of the abscess. When the abscess is very deep in the neck, it may not be possible to determine whether fluctuation is present, and in such cases one must be governed by the course of the temperature and by the symptoms.

Drainage is established by making a small incision through the skin over the fluctuant area or, in cases in which fluctuation cannot be made out, over the most prominent portion of the swelling. An ordinary curved forceps is then thrust into the cavity of the abscess, and the opening is enlarged by spreading the forceps. This opening should be made large enough to admit a finger, and the interior of the cavity should be palpated. Occasionally it will be found advisable to make a counter-opening in order to secure dependent drainage. A cigaret drain is carried to the bottom of the abscess and sutured in place. If the cavity is large, it should be packed loosely with iodoform gauze in addition to the cigaret drain. This gauze is removed in from twenty-four to forty-eight hours; the cigaret drain usually is left in place for six or seven days.

Acute retropharyngeal abscesses usually are seen in infants and young children and are due to metastatic involvement of groups of lymph nodes posterior to the prevertebral fascia. These nodes undergo atrophy as the child grows older; consequently acute retropharyngeal abscesses are encountered infrequently in adults. These abscesses may become very large and sometimes interfere seriously with breathing. On opening them the precaution should be taken of lowering the head of the child and of using a suction apparatus to carry away the pus as it is evacuated, so that it does not go into the lungs.

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1. Beck, A. L.: A Study of Twenty-Four Cases of Neck Infection, Tr. Am. Acad. Ophth. **37**:342, 1932.

Ludwig's angina is an infection of the floor of the mouth which may be above or below the mylohyoid muscles; if the abscess is above it points inside the mouth, whereas if it is below it points in the submental region. A type of infection resembling Ludwig's angina, which is characterized by a tedious course with severe dysphagia and a marked systemic reaction, is due to abscess in the root of the tongue rather than under the tongue.

In cases of woody phlegmon there is diffuse brawny induration, often involving the entire side of the neck. Suppuration does not occur in these cases, and it may require as long as three months for the condition to subside. Treatment is carried out by means of hot packs and irradiation. The prognosis is good.

Years ago surgical dissection of the lymph nodes of the neck was done for tuberculous cervical adenitis. This has been abandoned almost entirely, however, because usually irradiation with the roentgen rays or radium clears up this condition satisfactorily. If, however, a lymph node suppurates and comes to the surface, it is advisable to drain it and gently curet the interior of the cavity in order to remove all the broken-down tissue. The usual general measures should be combined with these procedures, and the tonsils and any infected teeth should be removed.

A tuberculous retropharyngeal abscess may develop secondary to tuberculous caries of the cervical vertebrae. Such abscesses often extend down the anterior aspect of the vertebral column. Occasionally they rupture into the pharynx, and a granuloma may form at the site of rupture and lead to an erroneous diagnosis of malignant disease. In other cases such an abscess may burrow laterally into the posterior cervical region, and a draining sinus may be present on one or both sides. One case was encountered in which there was a tuberculous retropharyngeal abscess without tuberculous disease of the cervical vertebrae. It was believed to be due to suppuration of a tuberculous retropharyngeal lymph node.

The question arises whether it is advisable to drain a tuberculous retropharyngeal abscess. It is better not to do so unless drainage becomes imperative on account of interference with respiration or deglutition. If it is drained, secondary infection is almost certain to take place and render the problem more difficult. The usual treatment of Pott's disease should be carried out, and the entire abscess cavity may absorb.

Tuberculous thyroiditis is occasionally encountered. In one such case the condition was thought to be an infected cyst of the thyroglossal duct. There was a cystlike mass over the midportion of the neck anteriorly, but as soon as it was opened and the nature of the contents was observed the true condition was recognized. It probably originated from tuberculous disease in the region of the isthmus.

Cervical adenitis as a manifestation of syphilis is relatively uncommon. It is encountered most frequently in women in the secondary stage of syphilis. Such nodes usually remain firm and only rarely undergo degeneration.

Actinomycosis is a chronic disease characterized by the formation of tracts of granulation tissue which break down and form superficial abscesses. In many of these cases in which the head and neck are involved the infection is secondary to some trauma within the mouth, such as a dental extraction or an abrasion of the mucous membrane. Actinomycosis must be considered as a possible diagnosis in any case in which an inflammatory process is present about the face or neck which persists for a period of three weeks or more before suppuration occurs, especially if it is associated with a marked tendency to rigidity of the muscles in this region. In order to prove such a diagnosis it is necessary to find the characteristic granules in the pus. These are seen most readily in pus obtained from a previously unopened abscess or from a sinus which has become sealed by crusting and which has been closed for several days. If one examines pus from a continuously draining sinus, it is extremely difficult to demonstrate the granules.

Owing to the fact that the organism of actinomycosis is an anaerobe, the actinomycotic abscess is best treated by keeping it open for long periods with gauze or rubber drains in order to admit air to the interior of the wound. The patient is given large doses of potassium iodide and irradiation by the roentgen rays or radium. On the average, six months is required to bring about a cure. For patients who cooperate in the treatment the prognosis in cases of actinomycosis about the face and neck is very good. In a series of 143 patients who were cooperative there was only one death.

Blastomycotic cervical adenitis is an unusual condition. One patient was seen who had a lesion inside the mouth with the characteristic minute, yellowish superficial abscesses and with metastatic masses in the submental and submaxillary regions. The diagnosis was confirmed on microscopic examination of tissue from the lesion in the mouth. This patient was treated with potassium iodide and radium and made a complete recovery.

In cases in which there is acute infection in a branchial cyst it may be very difficult to determine whether the condition is an infected cyst or whether an acute suppurative process is present. A history of a preceding lump in the neck or of previous swellings may give the one necessary clue. A branchial cyst tends to give a tense cystic sensation on palpation. In a fair percentage of cases the infection subsides without drainage, and it is better to treat the patient conservatively, if possible, because if the cyst is opened the resulting scar tissue around it may make later removal difficult.

Cysts of the thyroglossal duct not infrequently become infected because of their connection with the pharynx. In these cases, also, later removal of the cyst is facilitated if rupture or drainage of the infected cyst can be avoided.

A congenital cystic hygroma is a tumor made up of multiple thin-walled lymph cysts. Such tumors become infected readily, and when this occurs the patient becomes extremely ill, owing to the ready absorption of toxic material from the thin-walled cysts. The mortality from this cause in such cases is probably very high.

I wish to reemphasize that it is much better to treat acute suppurative conditions of the neck conservatively. The results in our series of 103 cases, with only one fatality, demonstrate the value of this. I do not believe that it is good surgical judgment to open a wide wound in the neck to search for pus in the presence of what usually is a virulent infection.

I believe that in acute suppurative conditions in the neck, the pus does not burrow along the fascial planes as frequently as the anatomist would have one believe. Instead, in the vast majority of cases nature builds a barrier around the abscess and forces it to burrow toward the surface.

Our experience would lead us to believe that jugular thrombosis is an infrequent complication of acute suppurative conditions in the neck. The possibility of its occurrence always should be borne in mind, however, and there should be little difficulty in recognizing it, so that appropriate treatment can be instituted.

DESCENDING BONY FACIAL CANAL IN RELATION TO COMPLICATIONS OF MASTOIDECTOMY

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The bony facial canal is an integral part of the pars petrosa throughout its entire course. This applies to its embryologic development and to its surgical anatomy. Therefore, the conclusion may be accepted that it is closely related to pathologic changes in this portion of the temporal bone. In this presentation the term descending bony facial canal is construed to be that portion between the external semicircular canal and the stylomastoid foramen. Some criticism may be engendered by so limiting this area. In apology it may be said that the observations as presented, with their clinical and surgical conclusions, are based on observations limited to this portion of the canal and contiguous structures.

The internal aspect of the bony canal is the anatomic pathway to the bony area of the bulb and the inferior surface of the petrosal pyramid. Its cellular character is similar, varying in direct relation to the progress of invasion from the antrum and the middle ear, and it is normal or modified by early pathologic change provided one accepts the theory of Wittmaack.[1] Other investigators, notably Albrecht,[2] have expressed the belief that other factors are concerned with pneumatization. Seldom does cellular extension occur from the antrum prior to the second year of life.[3] Until that time the normal histologic appearance may be considered to be diploic.

In a previously reported series of observations on temporal bones the conclusions were made that they vary greatly as to their bony cellular structure.[4] This also applies to the descending portion of the bony facial canal. One of the methods used in making such observations was the cutting of sections through the plane of the descending

† Dr. Ziegelman died Oct. 12, 1934.

1. Wittmaack, K.: Internat. Zentralbl. f. Ohrenh. **19**:105, 1921; Arch. f. Ohren.- Nasen- u. Kehlkopfh. **130**:143, 1931.

2. Albrecht, W.: Zur Frage der Pneumatisation des Mittelohres: Histologische Untersuchungen am Schläfenbein des Neugeborenen, Acta oto-laryng. **14**: 221, 1930.

3. Beesley, Lewis, and Johnston, T. B.: A Manual of Surgical Anatomy, New York, William Wood & Company, 1916, p. 210.

4. Ziegelman, Edward F.: Cellular Character of One Hundred Temporal Bones: The Clinical and Surgical Significance, Surg., Gynec. & Obst. **60**:582 (Feb.) 1935.

portion of the canal and the macroscopic study of these sections. In a series of one hundred such sections made through adult temporal bones, seventeen were obtained in which the descending portion of the facial canal was opened throughout its longitudinal plane. This series afforded an opportunity to study the contents of the canal and its relations. The observations will be reported in detail at a future time.

The descending bony canal, frequently described as the mastoid portion, is a compact structure. It varies in length and diameter. In the series of seventeen specimens observed the average diameter in the superior portion was 4 mm. and at the stylomastoid foramen, 6 mm. Its length varied from 6 to 12 mm., depending on the size of the temporal bone. The contents of the canal, that is, the sheath, nerve and vascular supply, accounted for one third of its transverse diameter. In the upper portion these structures were more compactly placed than in the lower portion or at the stylomastoid foramen. This is of clinical and surgical importance in that edema or an inflammatory process involving the upper third of the canal would manifest itself by clinical evidence of a pathologic process earlier than would such an involvement of the lower third.

The cellular character of the retrofacial internal and anterior area related to the bony canal was observed to be as follows: Two were definitely diploic, two were pneumatic, one was sclerotic and twelve were of mixed type. Of those of mixed type, eight were predominantly diploic and four were pneumatic. The term predominance is used to indicate that type of cell most characteristic on gross study. The bulb cells, being a continuation of the retrofacial cells, were also investigated: Six were definitely diploic, one was pneumatic, two were sclerotic and eight were of mixed type. Of those of mixed type, five were predominantly diploic and three pneumatic. These findings show a variance between the cellular character of the retrofacial area and that of the bulbar portion. This is not surprising if one accepts the theory that the mucous membrane of the middle ear and antrum in its embryologic form regulates the cellular character of the temporal bone. The most interesting, and what I believe to be the most valuable, observation, especially referable to its clinical and surgical application, was that in five of the seventeen sections pneumatic cells had invaded the bony osseous canal to a place where they were separated from the contents of the canal by a tissue-paper thickness of bone. These cells were all of the mixed type. Their location varied: In three of the five specimens this close invasion was limited to the upper third of the facial canal and was circuitous, that is, located in relation to the retrofacial, internal and anterior aspects of the canal. In the other two specimens cellular invasion was demonstrated at various locations throughout the entire length of the canal. This was applicable to the posterior area. Such

invasion was not manifest in the anterior area but was present in the upper third of the internal aspect. These changes were so definite and impressive that their clinical and surgical importance was immediately visualized. Direct invasion of the lumen of the canal was not observed. Similar observations have been reported. MacKenzie's observations on the facial canal, which are frequently cited,[5] were somewhat similar to those presented here. His observations referred to the entire canal and included the labyrinth and the tympanic and mastoid portion.

Of the remaining twelve specimens of bony canals, nine showed varying degrees of diploic pneumatic invasion, though in none was the invasion of sufficient extent to warrant the assumption that it might serve as a portal of entry to the lumen of the canal. In three of the specimens the bony canal was sclerotic throughout its entire extent.

The following tabulation summarizes the observations on the cellular structure of the temporal bone and the bulb area directly associated with the descending portion of the bony facial canal.

	No. of Sections	Type of Cell			
		Diploic	Pneumatic	Sclerotic	Mixed
Temporal bone..	17	2	2	1	12
Bulb area.....	17	6	1	2	8

In specimens showing the mixed type of invasion diploic cells dominated in eight, pneumatic cells in four.

In specimens showing the mixed type of invasion diploic cells predominated in five and pneumatic cells in three.

Examination of the seventeen sections of the descending bony facial canal revealed extensive cellular invasion in five, moderate invasion in nine and invasion of the sclerotic type in three.

Two of these observations are of importance in their clinical and surgical application: The first is the relation between the retrofacial and the bulb cells, the former serving as a possible pathway from the antrum to the latter. Though the anatomy tends to warrant this deduction, clinical evidence does not coincide with it. Primary involvement of the bulb seldom occurs by way of the retrofacial area in involvement of the mastoid requiring surgical intervention. It seems to occur invariably by vascular transmission directly from the middle ear. The second observation is that invasion of a pneumatic cell or cells into the bony facial canal may occur to a point where localized infection can readily

5. (*a*) Smith, J. Morrisett: Decompression of the Facial Nerve for Postoperative Facial Paralysis: Report of Two Cases, Ann. Otol. **40**:1179, 1931. (*b*) Ney, K. Winfield: Facial Paralysis and the Surgical Repair of the Facial Nerve, Laryngoscope **32**:327, 1922. (*c*) Martin, Robert C.: Intratemporal Suture of the Facial Nerve, Arch. Otolaryng. **13**:259 (Feb.) 1931.

break into the structure either independently or by trauma during a surgical procedure. This would automatically open the canal and expose the sheath and its contents. Though my series was relatively small I was impressed with the fact that such a condition is possible and must be given due consideration. The fact that in five of the specimens the cellular invasion was present in the upper third of the internal aspect probably explains why a gouge or curet seldom comes in contact with these cells during surgical procedure on the mastoid. It is a difficult area to approach surgically without great hazard to the contents of the canal.

Otitic or mastoid pathologic change at times demonstrates invasion of the facial canal with evidence of facial paralysis which may subside with or without surgical intervention. Fatal termination by way of purulent meningitis is frequent unless intervention is carried out. This pathologic process has been explained on the basis of periostitis of the facial canal [5b] and susceptibility to compressive lesions caused by the fact that it traverses a bony canal which it completely fills; [5a] it has also been explained by the presence of dehiscences. I have seen osteitis of the facial canal with sequestration and the development of permanent facial paralysis on removal of such sequestrum. This early observation left an indelible impression. It has made me extremely cautious when the urge may be present to remove loose spicules of bone from deep and blind areas in mastoidectomy wounds.

The observations as presented clearly show an added basis on which the development of facial paralysis may be explained. Many surgeons have had the unfortunate experience of seeing facial paralysis develop following surgical intervention on the mastoid. This paralysis may be transitory or permanent or may end with fatal meningitis. These surgeons were masters of the anatomy of the part, honest in their analysis of the results and confident that no important structure had been opened to purulent invasion. They were compelled to lay such complications to the presence of dehiscences or other vague pathologic processes. The observations presented here definitely prove that an occasional invasion of the bony facial canal by way of pneumatic cells can account for such pathologic change and the complications. Whether the reported observations are a cross-section of all the conditions in temporal bones I am unable to state. The question should be given due consideration. This applies to the anatomy, the concomitant pathologic process, the clinical manifestations and the surgical application.

CONCLUSIONS

1. The bony facial canal varies in length and diameter.

2. The cellular character of the retrofacial area and that of the bulb area have some characteristics in common.

3. In some temporal bones pneumatic cells invade the bony osseous canal to a point of great clinical and surgical importance.

4. The observations presented warrant the belief that disturbed physiologic relations of the facial nerve, whether transitory or based on a definite pathologic process with recovery or death by meningitis, must be analyzed on the added basis of cellular invasion of the bony canal.

5. Not all facial paralysis, either transitory or with a fatal termination, following operative procedure on the mastoid, is due to error in surgical technic.

INFLUENCE OF THE MIDDLE EAR ON LABYRINTHINE PRESSURE

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The majority of investigations on labyrinthine pressure have been made by histologic methods. Most of the authors have come to the conclusion that the labyrinth is well protected against all changes in nonacoustic pressure and that it possesses a constant static pressure. This conclusion was based on the fact that the investigators, with few exceptions, could find no evidence of increased pressure in the inner ear when reviewing the microscopic slides made in clinical cases or in experiments on animals.

In studying this problem, it is essential to know the amount of pressure needed to produce histologic changes in the labyrinth. As relatively large changes in pressure must occur before any changes in the labyrinth can be detected histologically, it is obvious that the histologic method cannot be used in the study of small changes.

In a former paper I reported that it is possible to observe exceedingly small changes in pressure in the labyrinth by physiologic methods and to determine their effects on the function of the cochlea. An attempt was made to study the relationship between intracranial and labyrinthine pressure. In the present paper I wish to report on some experiments which have been performed for the purpose of showing the effect of changes in the pressure in the middle ear on the intralabyrinthine pressure.

Although there are two membranous communications, in the form of windows, between the middle and the inner ear, it has not been definitely accepted that a change in the static pressure of the middle ear is transferred to the inner ear. If there is any change in the pressure in the middle ear which acts equally on the two windows, the labyrinthine fluid, according to this assumption, would not be displaced because of the lack of means of escape. Frank,[1] in investigations on a model of the middle ear, found that if the two windows of the model were absolutely equal, no displacement of fluid took place in the labyrinth.

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1. Frank, O.: Die Leitung des Schalles im Ohr, Sitzungsb. d. Gesellsch. f. Morphol. u. Physiol. in München. (1922) **24**:34, 1923.

With regard to the changes in the dynamic pressure—in other words, the acoustic oscillations—the function of the middle ear is interpreted as follows: Acoustic waves are directed from the ear drum over the ossicular chain to the oval window. When the foot-plate of the stapes moves inward, it displaces labyrinthine fluid toward the membrane of the round window, which then moves outward, and vice versa. Furthermore, if a condition is present in which acoustic waves are directed equally and simultaneously to the round and to the oval window, no movement or displacement of the labyrinthine fluid takes place. This theory is used to explain the impairment of hearing which is associated with a lack of the apparatus of the middle ear, both the round and the oval window being directly exposed to the sound waves. In a similar manner the therapeutic effect of the so-called "artificial ear drum" is explained. When a large perforation in the ear drum is present, sound waves can pass directly to both windows, but when the perforation is closed by the artificial drum the transmission of the waves to the round window is prohibited.

Observations along similar lines were reported by Bárány.[2] He introduced a drop of mercury into the niche of the round window in patients who lacked an ossicular chain. The improvement of hearing thus obtained was explained by him as follows: The air which is locked between the membrane of the round window and the drop of mercury permits a satisfactory compensation for the movements of the membrane of the round window. On the other hand, the mercury prevents the sound waves from reaching the round window directly. Bárány described this as producing a "sound shadow" for the round window.

From the foregoing clinical and experimental considerations one is inclined to consider that no communication of static pressure is possible between the middle and the inner ear. Various experiments on the cadaver seem to prove the opposite. Many years ago Politzer,[3] Bezold[4] and Herzog[5] observed movements of the labyrinthine fluid when the pressure of the middle ear was changed via the eustachian tube. However, these experiments were relatively crude and were performed without quantitative calculations. So they cannot be accepted in attempting to answer the question as to whether or not changes

2. Bárány, R.: Versuche über die Wirkung des künstlichen Trommelfelles und ihre Erklärung, Verhandl. d. deutsch. otol. Gesellsch. **19**:81, 1910.

3. Politzer, A.: Lehrbuch der Ohrenheilkunde, ed. 4, Stuttgart, Ferdinand Enke, 1901.

4. Bezold, F.: Ueber die funktionelle Prüfung des menschlichen Gehörorgans. Gesammelte Abhandlungen und Vorträge, Wiesbaden, J. F. Bergmann, 1897-1909.

5. Herzog, H.: Mechanik des Fistelsymptoms, Verhandl. d. deutsch. otol. Gesellsch. **19**:247, 1910.

occur in the pressure in the middle ear during life that are strong enough to have an effect on the labyrinth. For this reason the following opinion was expressed in Denker and Kahler's handbook:[6] "There seems to be no increase of pressure in the labyrinth worth mentioning during temporary increase of pressure in the middle ear, for instance during coughing or sneezing because of the described anatomical conditions." The authors of the particular chapter from which this quotation is taken stated that there is only one type of movement for the intralabyrinthine fluid, that is, the acoustic oscillations of the fluid between the two windows induced by the pressure and suction movements of the foot-plate of the stapes. In other respects the fluid of the inner ear is compared to "stagnant water."

With such a background the present experiments were begun in order to attempt to answer the following questions:

1. Are changes in the pressure in the middle ear transferred to the inner ear?

2. What amount of change in the pressure in the middle ear is needed to produce a demonstrable movement of the labyrinthine fluid?

3. Are the changes in pressure of a kind that can exist during life?

4. What is their effect on the function of hearing?

In order to answer the first question, experiments were performed on living and on dead rabbits and dogs, by the following method:

General anesthesia, when needed, was obtained by an intravenous injection of ethyl carbonate (urethane). With the animal lying in a recumbent position the anterior part of the cervical region was entered and the bulla ossea was exposed and opened. A small opening was then drilled in the cochlea or the posterior vertical semicircular canal, and a delicate capillary tube was inserted in this hole, which was then sealed with balsam. Into the opening in the bulla a hypodermic needle or a glass tube was inserted and the bulla made air-tight with balsam or with plaster of paris. An enlarged image of the meniscus in the capillary tube was produced by an optical system and the movements of the meniscus could be observed against a screen or photographed with an optical kymograph (fig. 1).

Former investigators also have used glass capillary tubes, but they have not employed an optical system. The direct observation of the meniscus in the tube either with or without a lens is not desirable since relatively large errors in reading may occur by this method as a result of parallax or movement of the animal, etc. The projection on a screen permits easier reading and more accurate quantitative calculations.

A syringe connected through a tube with the opening in the middle ear was used for the production of pressure. The amount of pressure used was read on a manometer which registered simultaneously on the screen. The site of the

6. Denker, A., and Kahler, O.: Handbuch der Hals- Nasen- Ohren- Heilkunde, Berlin, Julius Springer, 1926, vol. 6, p. 458.

meniscus during rest was marked on the screen. After this a change in the pressure in the middle ear was produced. If the meniscus moved, the new position was recorded.

The results obtained with this method (whether on dead or on living rabbits or dogs) show uniformly that a change in the pressure in the middle ear is followed by a movement of the fluid in the inner ear. The results of these experiments do not agree with the statement of the authors of the chapter in Denker and Kahler's handbook that an increase in the pressure in front of both windows has no effect on the labyrinthine fluid and that the column of fluid that is "stretched in a frame" between the two windows is unaffected by changes in non-

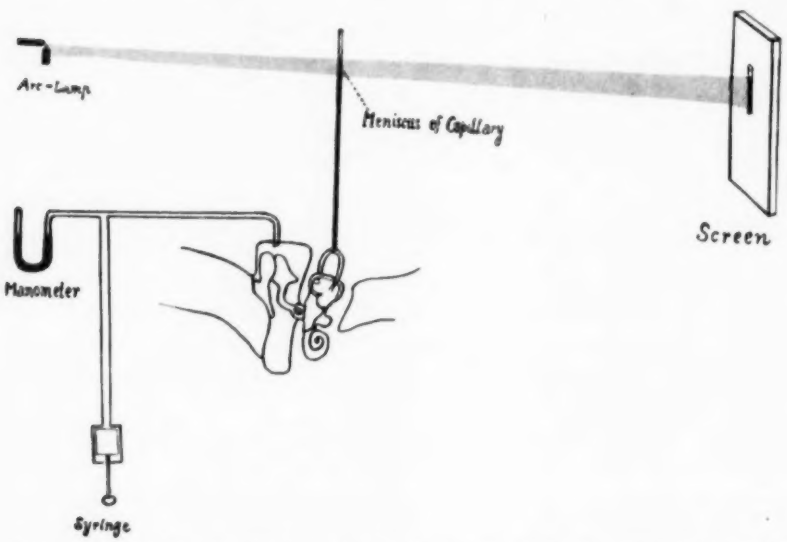

Fig. 1.—Diagram illustrating the method recording the movements of the labyrinthine fluid caused by changes in the pressure in the middle ear.

acoustic pressure. On the contrary, the results of the present experiments seem to show that each definite change in the pressure in the middle ear produces an effect on the labyrinthine fluid.

The qualitative experiments were followed by quantitative tests, which were essential in order to determine whether or not from a physiologic standpoint such a change in pressure can occur during life.

The amount of fluid in the inner ear which was displaced by a change in the pressure in the middle ear was computed according to the following formula: $V = \frac{a}{q} \times \pi r^2$. V equals the number of cubic millimeters of labyrinthine fluid, a equals the shifting of the meniscus as indicated on the board; q equals the coefficient of the enlargement provided by the optical system; r equals the radius of the capillary tube, measured under the microscope. After the experiment was finished

the position at which the meniscus had stood in the tube during the experiment was marked by a piece of putty, and the diameter was measured under the microscope using the square of a hematometer as an index. The marking of the site of the meniscus was important, for it is not to be expected that the lumen of a handmade capillary tube will have a uniform diameter.

By this experimental arrangement the amount of labyrinthine fluid which was displaced at a given pressure was calculated, and it was found that such a small change in pressure as 2 cm. of water produced an excursion of 0.2 cm. of the image of the meniscus on the screen, indicating that 0.02 cu. mm. of fluid had been displaced. The dependence of the movements of the labyrinthine fluid on the amount of pressure in the middle ear is shown in figure 2.

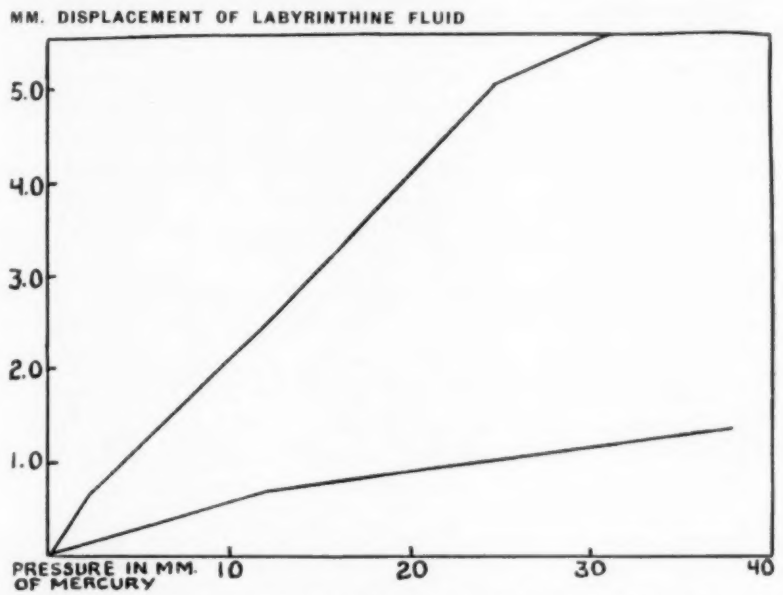

Fig. 2.—Curves showing the displacement of labyrinthine fluid as a result of changes in the pressure in the middle ear. The upper line indicates the displacement resulting from changes in the negative pressure; the lower line, that caused by changes in the positive pressure.

When the displacement of labyrinthine fluid due to a change in the pressure in the intracranial cavity was compared with that due to a change in the pressure in the middle ear, it was found that it was much easier to create a movement of the labyrinthine fluid from the middle ear. The smallest amount of change in the pressure in the middle ear that produced a visible movement of the meniscus was 0.3 cm. of water. The corresponding threshold for a change in the pressure in the intracranial cavity was from 10 to 15 cm. of water. It is assumed that any considerable movement of the labyrinthine fluid

caused by a change in the static pressure in the middle ear may create a movement of fluid toward the intracranial cavity through the aquaeductus cochleae. A flow in the opposite direction may occur when there is negative pressure in the middle ear.

Because of the possibility of unforeseen errors, too much significance cannot be ascribed to the results obtained, but the values are of aid in determining whether or not such a displacement of fluid may occur during life. The changes in the pressure in the middle ear caused by coughing, sneezing, yawning, swallowing, Valsalva's experiment, etc., are relatively high, and it is evident that they are greater than those used in the present experiments. Hence, these experiments seem to indicate that the labyrinthine fluid is not "stretched in a frame" and that it is not immune to changes in the static pressure in front of the two windows.

The assumption of frequent static movements of the labyrinthine fluid raises the question as to the manner in which the movements of the perilymph produce a change in the function of hearing. An attempt was also made to investigate this problem by means of animal experimentation, the reflex of the tensor tympani muscle being used as a "hearing indicator." As is well known, the two muscles of the middle ear show tetanic contractions when exposed to sound, and the duration, the intensity and the pitch of the sound determine the character of the contraction. This reflex is constant. In the present paper further explanations as to the peculiarities of this reflex cannot be given, but it may be mentioned that the reflex enables the research worker to estimate the cochlear function in an experimental animal. The observation of the reflex movement of the tensor tympani muscle was carried out by two methods.

The first method was that of opening the bulla and observing the muscle through a lens. The second method consisted of opening the bulla and transfixing the muscle with a small hook, connected by means of a silk thread to an extremely mobile wheel. This wheel carried a little mirror on its axis. If the muscle contracted, the hook, and with it the wheel, moved so that the mirror on the axis changed its position and altered the direction of the reflected beam of light. The deviation of the beam of light indicated the degree of the contraction.

For the production of sound an audiometer [7] connected with an amplified system and a loud speaker was used. The intensity of the pitch which would produce the smallest visible contraction (threshold contraction) was recorded.

The "hearing test" in rabbits corresponded closely to the hearing test carried out in the clinic, the difference between them being that the patient says which sound is the lowest that he can hear (threshold of hearing), but in the animal it is necessary to estimate the threshold

7. Western Electric 2-A.

by means of the visible contraction of the muscle. The comparative value of these two methods of testing cannot be discussed here.

It must be considered that the reflex movement is maintained by both labyrinths; for instance, the reflex movement of the right tensor tympani muscle is maintained after destruction of the right labyrinth because impulses are obtained from the left labyrinth. In order to make a hearing test on one labyrinth, it is necessary to destroy the other labyrinth. Nonacoustic movements of the tensor tympani muscle are described in the literature, but they are rare and easily avoided. The experiments were performed as follows:

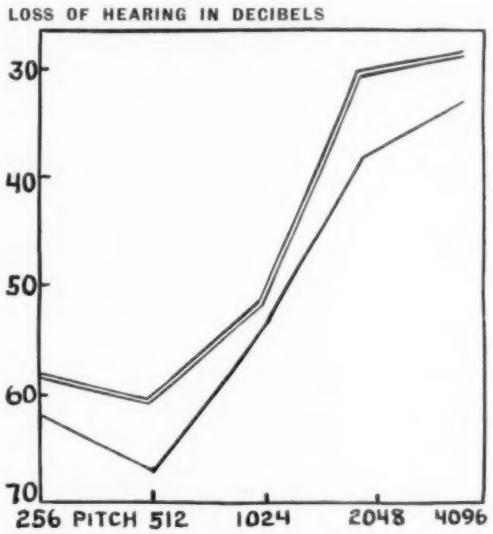

Fig. 3.—Curves showing that no change in the tensor tympani muscle reflex was noted after a slight change in the pressure in the middle ear but that a definite impairment of the reflex was noted after a great increase in the pressure in the middle ear. The upper line represents the hearing function under normal pressure; the middle line, under a pressure of 8 cm. of water; the lower line, under a pressure of 12 cm. of water.

Superficial general anesthesia was induced by the intravenous injection of ethyl carbonate (urethane) with the rabbit in a recumbent position. The right bulla ossea was exposed and opened, and the tensor tympani muscle was exposed. The left bulla also was opened, and a tube was inserted tightly so as to permit the production of changes in the pressure in the left middle ear. At first the readings were taken under normal conditions, and then under modified pressure. The same procedure was carried out after destruction of the right labyrinth.

As shown by the curves in figure 3, there was no striking difference in the threshold of the contraction when the pressure in the middle ear was normal or moderately increased This result seems remarkable

when it is remembered that this degree of change in the pressure was followed by a definite movement of the labyrinthine fluid in the capillary tube in the former experiments; in fact, movements of the meniscus resulted from changes in pressure that were less than one sixth of this pressure. Because no change in the muscle jerks was noted, it was concluded that this amount of change in the pressure was not sufficient to impair the afferent cochlearis impulses. In other words, if the reflex was not definitely changed, it was concluded that the hearing probably was not changed grossly, since the degree of the perception

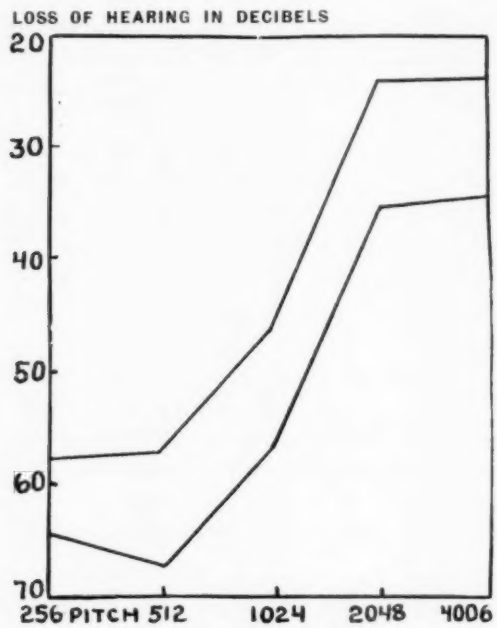

Fig. 4.—Curves showing the stronger impairment of the tensor tympani muscle reflex caused by a greater change in the pressure in the middle ear. The upper line represents the reflex under a normal pressure; the lower line, the reflex under a pressure of 20 mm. of mercury.

of hearing is believed to run parallel to the degree of muscular contraction. Similar experiments in which the intracranial pressure was changed gave like results.

On the other hand, the results were entirely different when higher pressures were used (fig. 4). In these experiments the effects of changes in the pressure in the middle ear were definite. The contractions were decreased both with positive and with negative changes. Pressures of only a few millimeters of mercury were used so as not to destroy the ear drum, an exceedingly thin membrane in the rabbit.

To demonstrate the definite decrease of the muscular contractions, the readings were taken under the following conditions:

The observer of the reflex movements was not instructed as to whether or not the pressure in the other ear was changed. However, he was always able to determine by the degree of muscular contraction whether or not the pressure had been altered.

On the basis of these experiments it may be assumed that weak changes in pressure in the middle ear do not produce changes in the contraction of the tensor tympani muscle, but higher degrees of negative and of positive pressure definitely impair the contractions and, as one would like to assume, impair the hearing ability.

Hence, it becomes evident that the clinical question as to whether or not a change of pressure in the intracranial cavity or in the middle ear produces a change in the function of hearing cannot be answered simply by "Yes" or "No," because the alteration of the ability to hear is probably dependent on the degree of the change in pressure. It appears that the lack of quantitative investigations may explain the presence of conflicting statements in the literature. The presence of normal hearing does not warrant the assumption that there has been no change in the labyrinthine pressure.

CLINICAL DEDUCTIONS

The influence on the labyrinth of a change in the pressure in the middle ear cannot be determined without a satisfactory knowledge of the effect on the aquaeductus cochleae. For this reason a thorough investigation was made along that line before the experiments were started, and an interesting fact was revealed, namely, that the resistance of the aquaeductus cochleae to periodic movements of fluid increases with the frequency of the movements. Extremely slow changes in pressure of the cerebrospinal fluid go entirely through the aquaeductus, but changes of higher frequencies do not seem to pass through this canal.[8] This peculiar feature seems to be important for the function of hearing. If every periodic change in pressure transmitted from the stapes passed by the labyrinth and went toward the intracranial cavity through the aquaeductus, there would be no irritation of the basilar membrane. On the other hand, the aquaeductus works as a safety valve for the changes in static pressure by allowing a free flow of labyrinthine fluid toward the intracranial cavity.

Several clinical observations may be correlated with these phenomena of pressure, for example, the Politzer method of inflation, which is supposed to reestablish the normal pressure in the middle ear and the

8. Kobrak, H.: Untersuchungen über den Labyrinthdruck, Ztschr. f. Hals-, Nasen- u. Ohrenh. **34**:456 (Sept. 16) 1933.

normal shape and tension of the ear drum. However, the pressure of the air as it enters the tympanic cavity must also affect the inner ear. The pressure in the middle ear during the inflation is remarkably high, the pressure produced by the bag being described as from 100 to 150 mm. of mercury. It is astonishing that damage to the inner ear is not produced by politzerization. This may be explained by the fact that there is a free movement of the labyrinthine fluid intracranially when the pressure of the labyrinth is greater than the pressure of the intracranial cavity;[9] hence, it may be assumed that there will be no stagnation of pressure in the inner ear after the inflation. Nevertheless, cases have been described in the literature in which seizures typical of Ménière's disease followed politzerization. It is not easy to explain why a few patients present symptoms following the harmless and often used procedure of politzerization. Perhaps the labyrinth is in a stage of higher irritability and so responds in a higher degree to these smaller irritations. On the other hand, it is possible to explain these symptoms mechanically. As was shown formerly, the conclusion was reached, following animal experimentation, that the passage between the labyrinth and the cranial cavity may be variable. If the same is assumed to obtain in man, it may be supposed that in certain cases the resistance is greater and that the pressure of the labyrinthine fluid is not dispersed intracranially, as is usual, but is confined to the labyrinth. How the difference in the motility of the fluid may be explained in each case has not been determined. There may be a change in the viscosity of the labyrinthine fluid or a reduction of the lumen of the aquaeductus cochleae due to the presence of desquamated epithelial cells, connective tissue fibers, stagnated blood, etc.

Another means of tympanogenic influence on the labyrinthine fluid may be through the muscles of the middle ear. In order to explain these changes, it may be mentioned that normal acoustic irritations of medium grade produce a tetanic contraction of both muscles of the middle ear. Strange to say, the ear drum does not show any movement, although the tensor tympani muscle is inserted on the malleus. The contractions of the tensor tympani muscle are almost absolutely isometric. In the same way the movements of the plate of the stapes are small. It is difficult and not always possible to show a movement of labyrinthine fluid after medium grade acoustic irritation. The louder the tone, the greater the contraction, the larger the movements of the plate of the stapes and, correspondingly, the more extensive the displacement of the labyrinthine fluid. It is of interest in this connection that a number of patients mention that they become dizzy when they

9. Kobrak, H.: Untersuchungen über den zusammenhang zwischen Hirndruck und Labyrinthdruck, Beitr. z. anat. Physiol., Path. u. Therap. d. Ohres **31**:216 (June) 1934.

hear extremely loud sounds. One explanation may be that strong acoustic irritations produce a great contraction of the muscles of the middle ear and displace the labyrinthine fluid to such an extent that vestibular symptoms develop. Another explanation may be that the great amplitude of the strong tone produces an oscillation of the labyrinthine fluid that is strong enough to cause vestibular symptoms. However, such an influence of the dynamic movements of the cochlea on the vestibular organ is unlikely. Although the two fluid systems are openly

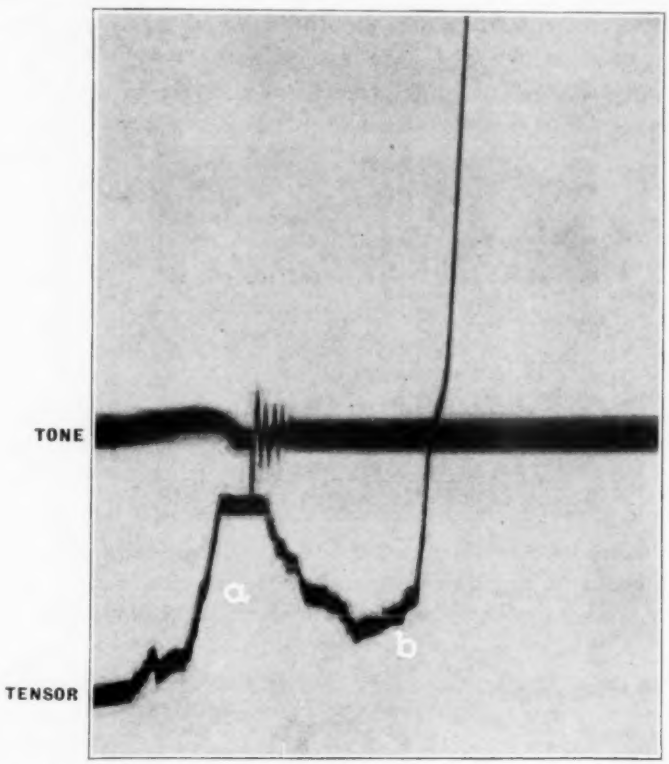

Fig. 5.—Tracing showing the contraction of the tensor tympani muscle due to (*a*) acoustic irritation and (*b*) irritation caused by nicotine. The contraction which followed the application of nicotine was so great that the beam of light passed beyond the limits of the film. This record and the one shown in figure 6 were taken in the Physiologisches Institut der Universität Heidelberg.

connected, it is likely that a system of connective tissue trabeculae, situated between the canals and the remainder of the perilymphatic system, prevents the transmission of dynamic movements to the canals. So it seems that the explanation of these vestibular symptoms is better given as a static movement of the labyrinthine fluid caused by the action of the muscles of the middle ear.

Another type of contraction of the muscles of the middle ear beyond physiologic limits which affects the labyrinthine fluid and the function of the labyrinth may be caused by some pharmacologic action. One of the drugs that induces a strong contraction of the tensor tympani muscle is nicotine. In one series of experiments a drop of a 1 : 1,000 solution of nicotine was placed on the surface of the muscle, which in rabbits passes freely through the tympanic cavity, and caused a strong contraction (fig. 5).

An attempt was made to measure the amount of the contraction by the instrument which had been used for the registration of the acoustic contractions. As figure 5 shows, the contraction was so much

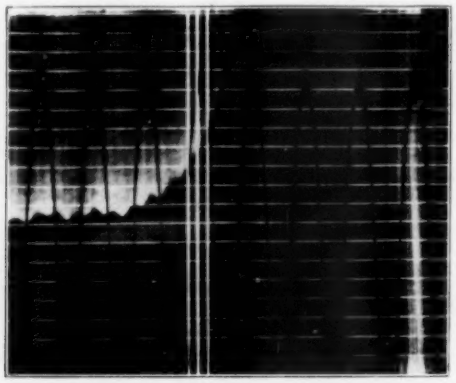

Fig. 6.—Tracing showing the movement of the labyrinthine fluid due to instillation of nicotine on the tensor tympani muscle. The meniscus shows a climbing corresponding to the muscular contraction that is shown in the former figure.

stronger than the acoustic contractions that the curve left the kymograph. When a larger screen was used, it was found that the proportion between the contraction caused by the nicotine and the physiologic contraction varied from about 1 : 5 to 1 : 10. It must be admitted that the recording device had not been constructed for large excursions and that possibly the readings could not be considered as absolutely accurate. However, the results were sufficiently accurate to indicate that nicotine produces a strong contraction of the tensor tympani muscle and that the contraction moves the labyrinthine fluid in the same way as does a contraction due to sound waves (fig. 6).

It is evident that these curves are running parallel. For displacements of the labyrinthine fluid resulting from the use of nicotine, no corresponding clinical observations are available. Whether the exces-

sive use of nicotine is able to produce contractions of the muscle of the middle ear and thus affect the labyrinth is not known, but it may be assumed that there are some still unknown modes of changing the tonus or of contracting the muscles of the middle ear which result in the involvement of the labyrinthine pressure during life. Some clinical experiments made by Krassnig [10] showed results which seem to support these assumptions. He injected cocaine into the middle ear of patients with perforation of the ear drum and both cochlear and vestibular symptoms developed. The hearing was impaired as it is in middle ear deafness, with symptoms of increased bone conduction and of a change of the lower limit of tone perception. The vestibular symptoms presented a typical Ménière syndrome. It is possible that the symptoms may be explained as an effect of the contraction of the muscles of the middle ear with involvement of the labyrinthine fluid in the same way as is experimentally shown in figure 6.

CONCLUSION

By means of the experiments described an attempt has been made to show that the labyrinthine fluid, although it is well protected by firm bone against mechanical injuries, is subject to influence in several ways. The communication with the cavity of the skull links the intracranial pressure with the labyrinthine pressure. On the other hand the labyrinthine fluid may be influenced from the outer or from the middle ear. It is the purpose of this paper to indicate how much more easily and, as may be assumed, how much more frequently changes in the labyrinth are caused by changes in the middle ear. For clinical purposes two assumptions may be made: From the diagnostic standpoint, it may be said that diseases of the inner ear may be due not only to organic lesions in the labyrinth, as is assumed for the classic Ménière syndrome (hemorrhage in the inner ear), or to changes in the blood supply (angiopathic Ménière syndrome), but also to alterations in the pressure in surrounding parts (middle ear, intracranial cavity). One may refer to the symptoms seen in Krassnig's experiments, to the changes seen in the present experiments and to the development of the Ménière symptoms after inflation as instances of a "tympanogenic" Ménière disease, or, to use a wider term, "tympanogenic labyrinthopathia." It would be worth while to include these possibilities of disease of the labyrinth when making a differential diagnosis. Furthermore, therapeutic results may be obtained by influencing the labyrinth from without by means of procedures carried on in the middle ear. This type

10. Krassnig, M.: Cocainwirkung auf das Mittel- und Innenohr, Ztschr. f. Hals-, Nasen- u. Ohrenh. **31**:384, 1932.

of treatment not only is theoretically assumable but has been tried. For instance, Krabowski treated patients with Ménière's disease by inserting a Siegle speculum in the outer ear. By means of movements of the whole ossicular chain he attacked the labyrinth and produced a favorable effect.

SUMMARY

1. Changes in the pressure in the middle ear are transferred to the labyrinth.

2. The smallest change in pressure that was necessary to produce a movement in the labyrinthine fluid in rabbits as determined by our apparatus was approximately 0.3 cm. of water.

3. The changes of pressure in the middle ear that occur during life (swallowing, coughing, sneezing and Valsalva's experiment) are equal to or greater than those which were found to be necessary in order to cause a movement of the labyrinthine fluid.

4. Extremely small changes in pressure in the middle ear do not produce changes in the acoustic reflex of the tensor tympani muscle. Greater changes in the pressure in the middle ear, either positive or negative, produce a decrease in the degree of the contraction.

5. The difference between the effect of a change in the dynamic pressure and the effect of change in the static pressure was discussed. The resistance in the aquaeductus cochleae may be dependent on the frequency of a periodic change in the pressure.

6. An attempt has been made to explain the clinical symptoms that develop after a change in the pressure in the labyrinth arising from the middle ear (disturbance after inflation, vertigo during strong acoustic sounds, the symptom complex described by Krassnig and vertigo after massage of the ear drum).

7. The fluid of the inner ear can be displaced by the contraction of the intrinsic muscles of the ear. A tetanic contraction of the tensor tympanic muscle caused by nicotine produces a strong movement of the labyrinthine fluid.

TRACHEOBRONCHIAL ASPIRATION OF BUCCOPHARYNGEAL SECRETION DURING ETHER ANESTHESIA

IMMEDIATE POSTOPERATIVE BRONCHOSCOPIC STUDY OF TWENTY-ONE PATIENTS

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CINCINNATI

Postoperative pulmonary complications, especially of the suppurative type, have been suspected of being induced by one or the other of two principal mechanisms, aspiration into the lower respiratory passages and vascular embolism. Many excellent studies have been made in an effort to substantiate or disprove one or the other of these modes of pathogenesis. One line of investigation has concerned itself with the demonstration of two types of aspiration and their sequelae—(1) aspiration of secretions from the mouth, nose or pharynx or from all of them in anesthetized animals and in patients following operations on or adjoining the pharynx or on parts draining into the pharynx and (2) aspiration or insufflation of infective material in animals. The other line of investigation has concerned itself with the localization and sequelae of various septic emboli introduced into the venous circulation. Some of the principal proponents of the circulatory mechanism are Cutler and Hunt,[1] Schlueter and Weidlein [2] and their associates and Fetterolf and Fox.[3] For further articles the reader is referred to the papers by these authors, since I shall not be further concerned with this

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Thesis submitted to the Faculty of Otolaryngology of the Graduate School of Medicine of the University of Pennsylvania in partial fulfilment of the requirements for the degree of Master of Medical Science in otolaryngology.

1. (*a*) Cutler, E. C., and Hunt, Alice M.: Postoperative Pulmonary Complicatons, Arch. Surg. **1**:114 (July) 1920; Postoperative Pulmonary Complications, Arch. Int. Med. **29**:449 (April) 1922. (*b*) Cutler, E. C.: The Experimental Production of Abscess of the Lung, Am. J. Dis. Child. **38**:683 (Oct.) 1929.

2. Schlueter, S. A., and Weidlein, I. F.: Postoperative Lung Abscess: An Experimental Study, Arch. Surg. **14**:457 (Feb.) 1927. Weidlein, I. F., and Hermann, L. G.: Abscess of the Lung: Experimental Studies in Chronicity, J. A. M. A. **91**:850 (Sept. 22) 1928.

3. Fetterolf, G., and Fox, H.: The Reaction of Paratonsillar Tissue to Tonsillectomy: Study in Etiology of Post Tonsillectomy Pulmonary Abscess, Am. J. M. Sc. **166**:802, 1923. Fetterolf, G.: Suppurative Disease of the Lung as a Complication of Tonsillectomy and Other Operations on the Upper Air Passages, in Jackson, C., and Coates, G. M.: The Nose, Throat, and Ear and Their Diseases, Philadelphia, W. B. Saunders Company, 1929, p. 316.

mechanism. Only the subject of aspiration into the lower respiratory passages will be reviewed and further elaborated.

As early as 1898, Hoelscher [4] (as cited by various reviewers) demonstrated that buccal secretions, previously stained, were noted in the tracheobronchial tree and even in the alveoli of etherized animals. He also observed that these secretions caused pneumonitis. Corper [5] showed that particulate matter (including dead tubercle bacilli) suspended in liquid and instilled into the nose of an animal during ether anesthesia was aspirated. Where this material settled in the lung depended to a great extent on the posture of the animal; and the lesion produced depended on the nature of the particulate matter, the dead tubercle bacilli being able to cause lesions resembling typical pulmonary tuberculosis in human beings. Lemon [6] demonstrated that dye or a suspension of barium was drawn into the lower respiratory tract from the mouth of etherized dogs in any posture, except in the full Trendelenburg position.

The frequent occurrence of pulmonary suppuration, particularly of abscess, following operations on the pharynx and upper respiratory passages, such as tonsillectomy and adenoidectomy, was shown by the well known statistics of several investigators. Moore,[7] from data obtained by questionnaire, collected 202 cases of abscess of the lung, including 39 cases following local anesthesia. These cases were collected from an enormous series in which operations were performed on the throat, mouth and nose in that order of frequency. Schlueter and Weidlein [2] reported that of 1,908 cases of abscess of the lung which they collected, 515 (roughly 29.6 per cent) followed operation, and of this number 268 (roughly 52 per cent of the postoperative cases or 14.6 per cent of the total number) followed tonsillectomy. Hedbloom [8] recorded that 48 (roughly 32.8 per cent) of a series of 146 cases of postoperative abscess of the lung followed tonsillectomy. Glowacki [9] noted 1 case of abscess of the lung among 350 tonsillectomies and Keiper,[10] 1 among 781 tonsillectomies.

4. Hoelscher, R.: Experimentelle Untersuchungen über die Entstehung der Erkrankungen der Luftwege nach Aethernarkose, Arch. f. klin. Chir. **57**:175, 1898.

5. Corper, J. H.: Pulmonary Aspiration of Particulate Matter, Normally and During Ether Anesthesia, J. A. M. A. **78**:1858 (June 17) 1922.

6. Lemon, W. S.: Aspiration: Experimental Study, Arch. Surg. **12**:187 (Jan.) 1926.

7. Moore, W. F.: Pulmonary Abscess: An Analysis of Two Hundred and Two Cases Following Operative Work About the Upper Respiratory Passages, J. A. M. A. **78**:1279 (April 29) 1922.

8. Hedbloom, C. A.: The Surgical Treatment of Acute Pulmonary Abscess and Chronic Pulmonary Suppuration, J. A. M. A. **83**:1577 (Nov. 15) 1924.

9. Glowacki, B. F.: Pulmonary Abscess, A Study of 90 Cases, Laryngoscope **33**:153 (Feb.) 1923.

10. Keiper, G. F.: The Tonsil Question up to Date, Laryngoscope **31**:777 (Oct.) 1921.

At the same time other studies were being carried out to investigate the aspiration of blood and buccal secretions into the tracheobronchial tree during tonsillectomy. In 1922 Myerson [11] performed bronchoscopy on 100 children after tonsillectomy under ether anesthesia and demonstrated that 79 of them had aspirated the pharyngeal content into the tracheobronchial tree, despite the fact that the head of the table was lowered 45 degrees and that suction was used. In 1924 he repeated the experiment on another group of 100 patients and noted aspirated material in the tracheobronchial tree of 76 of them. Daily and Daily [12] reported that blood was present in the bronchial tree in 78 of 100 patients on whom bronchoscopy was done immediately after tonsillectomy. In a similar series of 100 cases at the Cincinnati General Hospital reported by Vail [13] blood was demonstrated in the tracheobronchial tree in 62 of the patients on postoperative bronchoscopic examination. In this series it was observed that in the majority of patients on whom "bloodless operation was performed" or in whom "the laryngeal reflex was present" little or no blood was present in the tracheobronchial tree.

Using an ingenious method, May, Thoburn and Rosenberger [14] reported aspiration in 12 of a series of 25 anesthetized patients studied roentgenographically instead of bronchoscopically. They placed iodized oil in small amounts in the pharynx and took roentgenograms of the chest at intervals during and after the operation; they were thus able to discern the amount and extent of aspiration. They "demonstrated in several instances that aspirated material may appear in the lung during an operation but at the conclusion of the operation may have been entirely eliminated."

Since there are many postoperative pulmonary complications, including posttonsillectomic abscesses, following local as well as general anesthesia, other studies were made on patients after tonsillectomy under local anesthesia to determine the presence or absence of aspirated material. Daily and Daily [12] noted blood in the lungs in 1 of 2 patients in whom the larynx was cocainized before tonsillectomy under local anesthesia. Iglauer [15] examined 50 patients by direct laryngoscopy and

11. Myerson, M. C.: Pulmonary Aspects of Tonsillectomy Under General Anesthesia, Laryngoscope **32**:929 (Dec.) 1922; Bronchoscopic Observations on Cough Reflex in Tonsillectomies Under General Anesthesia, ibid. **34**:63 (Jan.) 1924.

12. Daily, L., and Daily, R. K.: Bronchoscopic and Esophagoscopic Observations in Tonsillectomies, Texas State J. Med. **23**:277 (Aug.) 1927.

13. Vail, H. H.: Tracheobronchial Tree in Children, with Reference to Blood Aspirated During Tonsillectomy and Adenoidectomy Under Ether Anesthesia, Arch. Otolaryng. **8**:26 (July) 1928.

14. May, R. V.; Thoburn, T. W., and Rosenberger, H. C.: Aspiration During Tonsillectomy: A Roentgenologic Study, J. A. M. A. **93**:589 (Aug. 24) 1929.

15. Iglauer, S.: Aspiration of Blood into the Larynx and Trachea During Tonsillectomy Under Local Anesthesia: A Contribution to the Etiology of Lung Abscess, Ann. Otol., Rhin. & Laryng. **37**:231 (March) 1928.

tracheoscopy immediately following tonsillectomy performed with the patient under infiltration anesthesia and saw blood in the trachea in 19 of them. Furthermore, in this series the larynx was not cocainized, and the patient was encouraged to expectorate any blood that collected in the mouth. Iglauer observed that in several of the cases the inspired blood was "very tenacious." In 5 cases he modified the experiment by introducing iodized poppy-seed oil into the tonsillar fossae immediately after operation, without instructing the patient to swallow, and observed that in 2 cases the iodized oil entered a bronchus. Ochsner and Nesbit [16] had previously shown in an experiment similar to that of Iglauer that all the patients in a series of 5 persons aspirated iodized oil into the trachea and bronchi when attempting to swallow the oil.

By animal experimentation an even more direct relationship has been shown between the aspiration of infective materials and the production of postoperative pulmonary suppurative processes. After many early unsuccessful attempts by Aschner,[17] Lambert and Miller [18] and Cutler,[1b] Smith [19] in 1927 produced pulmonary abscesses in 20 per cent of a series of mice, guinea-pigs and rabbits by the endotracheal injection of materials scraped from the teeth of patients having pyorrhea. One half of the total number of animals died of pneumonia. Early in 1928 Crowe and Scarff [20] and Allen [21] and, later in the year, Joannides [22] produced abscesses in the lungs of dogs by the endotracheal insufflation of material from patients with fusospirochetosis. Harkavy,[23] in a comprehensive paper, reported the production of pulmonary suppuration in 5 (14.8 per cent) of a series of 27 dogs. The dogs received by bronchoscopic introduction into the lower lobes "0.5 cc. of a mixed culture of bacteria recovered from the sputum of patients with abscesses of the lung following tonsillectomy." In 3 of the 5 dogs abscesses with cavities developed, and in the fourth, suppurative pneumonitis; the fifth animal pre-

16. Ochsner, A. J., and Nesbit, W.: Pulmonary Abscess Following Tonsillectomy, Arch. Otolaryng. **6**:330 (Oct.) 1927.

17. Aschner, P. W.: The Pathology of Lung Suppuration, Ann. Surg. **75**:321 (March) 1922.

18. Lambert, A. V. S., and Miller, J. A.: Abscess of the Lung, Arch. Surg. **8**:446 (Jan.) 1924.

19. Smith, D. T.: Experimental Aspiratory Abscess, Arch. Surg. **14**:231 (Jan.) 1927.

20. Crowe, S. J., and Scarff, J. E.: Experimental Abscess of the Lung in the Dog, Arch. Surg. **16**:176 (Jan.) 1928.

21. Allen, D. S.: Etiology of Abscess of the Lung, Arch. Surg. **16**:179 (Jan.) 1928.

22. Joannides, M.: The Etiology of Pulmonary Abscess, Surg., Gynec. & Obst. **47**:449 (Jan.) 1928.

23. Harkavy, J.: The Pathogenesis of Aspiratory Abscess of the Lung: Its Possible Relation to Abscess of the Lung Following Tonsillectomy, Arch. Int. Med. **43**:767 (June) 1929.

sented evidence of a healed suppurative pulmonary process. Thirteen of the remaining dogs died of pneumonia. These observations, he believed, may be compared with those of Aschner,[17] who studied the pulmonary pathologic changes in material obtained from resections of the lobe performed by Lilienthal[24] on patients many of whom had posttonsillectomic suppurations of the lung. Aschner[17] classified these processes as (1) bronchiectasis, a general disease of the bronchi; (2) bronchiectatic abscess, a localized suppurative process in the course of a bronchus (observed particularly in the posttonsillectomic cases); (3) suppurative pneumonitis, a diffuse purulent process, and (4) extrabronchial abscess, a localized purulent process. Harkavy[23] concluded:

> If results obtained in dogs may be translated to the conditions occurring in man, it is suggested that following aspiration of infectious material from the upper respiratory tract, the current of events is as follows: (1) pneumonitis; (2) necrosis and cavity formation; (3) healing or persistence of the primary abscess with the formation of secondary bronchiectasis.

Jackson and Jackson[25] noted five distinct types of postoperative pulmonary complications in their bronchoscopic observations: (1) postoperative atelectasis, which chiefly followed abdominal operations and which was due to obstructive bronchial secretions, not suppurative at the onset; (2) posttonsillectomic complications, which chiefly followed tonsillectomy and other operations about the upper respiratory passages, which were suppurative from the onset and which were probably due to an infective embolic process, although possibly they resulted from an infective aspiratory accident; (3) foreign bodies, aspirated or inspired during operations in the region of the upper respiratory passages; (4) infarct, which may follow operations on any region; (5) pneumonitis, usually called postoperative pneumonia. They further stated that if atelectasis is not quickly relieved "by ventilation and drainage with the consequent reestablishment of the defensive power of the lung, the atelectasis is slowly succeeded by suppuration: first, in the form of drowned lung, purulent bronchitis; later, abscess, possibly bronchiectasis."

These observations may be compared with those of Aschner in his studies of pathologic specimens and with those of Harkavy in his studies on dogs.

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24. Lilienthal, H.: Resection of the Lung for Suppurative Infections with a Report Based on Thirty-One Operative Cases in Which Resection Was Done or Intended, Ann. Surg. **75**:257 (March) 1922.

25. Jackson, C., and Jackson, C. L.: Bronchoscopical Observations on Post-Operative Pulmonary Complications, Ann. Surg. **97**:516 (April) 1933; Postoperative Pulmonary Complications, Internat. Clin. **4**:151 (Dec.) 1932; Bronchoscopy for Pulmonary Diseases, in Jackson, C., and Coates, G. M.: The Nose, Throat and Ear and Their Diseases, Philadelphia, W. B. Saunders and Company, 1929, p. 1103.

The present study was made on the suggestion and under the direction of Dr. Samuel Iglauer, director of the department of otolaryngology, Cincinnati General Hospital, and professor of otolaryngology in the College of Medicine, University of Cincinnati.

PROBLEM AND MODE OF STUDY

Bronchoscopic observations were made immediately following operations, other than those on the upper respiratory passages, in a series of patients under ether anesthesia to determine whether saliva and other pharyngeal contents were aspirated. These studies differed from those of Myerson, the Dailys, Iglauer, Vail, Ochsner and Nesbit and May and his co-workers in that the operations were on parts which, for practical purposes, do not drain into the pharynx. Thus it was hoped to eliminate two factors which influence the aspiration of secretion—first, the effect of bleeding in the operative field with the resultant material increase of the pharyngeal content and, second, the effect of the instrumental depression of the tongue occurring in tonsillectomy which, as Jackson stated, "prevents swallowing and creates a funnel leading to the always open larynx."

It was proposed to determine (1) the distributional or topographic extent of the aspirated material, (2) the amount of aspirated material following ether anesthesia and, if possible, (3) the effect of factors associated with each operative case on the aspiration in that case. With this in mind a series of 21 patients from the department of otolaryngology were subjected to bronchoscopy immediately after operation and while still under ether. In this series 18 patients were operated on for mastoiditis, 1 for fibroma of the external acoustic meatus and 2 for frontal sinusitis. (In the last two cases the choanae were blocked with postnasal packs to prevent leakage from the operative field into the pharynx.) No change was made in the usual technic of anesthesia or operation prior to bronchoscopy. Only patients whose general condition was good preoperatively as well as postoperatively were selected for study.

Ether given by the drop method was the anesthetic used in all the cases, but the quantity varied from 5 to 35 ounces (141.8 to 992.2 Gm.) and the duration of the anesthesia from forty-five to one hundred and eighty minutes (table 1). To identify the aspirated material a dye in aqueous solution, methylthionine chloride (methylene blue), was instilled into the pharynx of each patient after anesthetization and before the actual surgical procedure was started. Most of the patients received 3 drops; some were given as many as 20 drops.

Observations on the following items were made in each case:

A. Preoperatively

1. The operation to be performed, which determined the posture. The 19 patients with operations on the ear lay supine on a horizontal table with the head rotated to the unaffected side and resting on a small doughnut-shaped sand-bag and the shoulder on the operative side resting on a small rectangular sand-bag. The two patients with operations on the frontal sinus lay supine on a horizontal table with the head unrotated but with the communication from the nasal cavity to the pharynx blocked by postnasal packs to maintain an essential condition in the series of observations.
2. The age and sex of the patient. The age varied from 2 to 49 years, with 9 patients in the first decade of life (5 boys and 4 girls), 3 in the second decade (1 boy and 2 girls), 7 in the third decade (1 man and

6 women) and 1 in each of the fourth and fifth decades (both men)—a total of 9 males and 12 females.

3. Preanesthetic medication. The sedative depended on the age and sex of the patient. It consisted of from 1/60 to 1/4 grain (1.1 to 16.2 mg.) of morphine sulphate and from 1/800 to 1/150 grain (0.75 to 0.43 mg.) of atropine sulphate. For 1 patient codeine sulphate was used, and to several apprehensive patients sodium amytal or phenobarbital was administered.

B. During the operation

1. The presence or absence of the gag or laryngeal reflex at the time of instillation of the dye into the pharynx.
2. The amount of secretion present in the mouth and pharynx, which was determined by the anesthetist and recorded as (1) scanty, when there was only a small amount of saliva and other secretion and when no suction was used during the operation; (2) moderate, when an intermediate amount was present sufficient to interfere with breathing, and (3) profuse, when a large amount was present sufficient to interfere with breathing. In the last two groups suction was used one or more times. The differentiation between moderate and profuse secretions was difficult and, perforce, inexact. The amounts were not all estimated by the same anesthetist.

C. Bronchoscopically, immediately after the operation

Etherization was discontinued when the operation was completed and the wound dressed. The bronchoscopic examination was then performed during the short period of continuing anesthesia with the instruments and technic devised by Jackson. In order to avoid introduction of stained secretions into the bronchi with the instruments, the material present in the pharynx was removed by the suction-pump prior to bronchoscopy. The following observations were made:

1. The topographic distribution of aspirated material, as evidenced by the presence of dye in the various segments of the tracheobronchial tree. The larynx, trachea, right bronchus, left bronchus and bronchi of the inferior lobe were the only parts examined.
2. The quantity of material aspirated into the lower respiratory passages as a whole was estimated as (*a*) *scanty* when mere staining of the walls was seen beyond the bronchoscope; (*b*) *moderate*, when there was some stained material in the lumen, and (*c*) *profuse*, when the lumen and further view were obstructed by stained material.

The data obtained from the observations just outlined are listed in the accompanying tabulated résumé of the cases (table 1) in the order in which the observations are mentioned in the text. However, the order of cases in this résumé is not the same as the chronological order of examination; the cases were arranged for convenience in analyzing the data and to correspond with the order in the table of case analyses (table 2). Within each group in table 1, the cases are listed in order of the age of the patients.

ANALYSIS OF DATA

Aspiration of saliva and other stained material into the larynx or farther into the tracheobronchial tree occurred in 17 (roughly 81 per cent) of the 21 cases and into the trachea or lower in 16 (roughly 76

TABLE 1.—*Résumé of Data Cases*

Case	Duration of Anesthesia, Min.	Amount of Ether Used, Oz.	Amount of Dye (Methylthionine Chloride) Used, Drops	Site of Operation	Age of Patient, Years	Sex	Preanesthetic Medication, Grains	Gag (Laryngeal) Reflex at Instillation of Dye	Pharyngeal Content	Number of Times Suction-Pump Was Used	Aspiration of Pharyngeal Content					Estimated Amount Aspirated
											Larynx	Trachea	Right Bronchus	Left Bronchus	Bronchi of Inferior Lobe	
1	60	Not recorded	3	Right mastoid	8	F	Morphine 1/12 Atropine 1/400	—	Not examined	Not recorded	—	—	—	—	—	0
2	105	Not recorded	10	External frontal sinus	24	F	Morphine 1/6 Atropine 1/200	—	Not examined	Not recorded	—	—	—	—	—	0
3§	95	9	3	Right mastoid	20	F	Morphine 1/6 Atropine 1/200	+	Profuse	2	—	—	—	—	—	0
4	180	35	3	Left mastoid, radical	49	M	None	—	Moderate	0	—	—	—	—	—	0
5	120	Not recorded	3	Left mastoid	19	F	Morphine 1/6 Atropine 1/150	+	Not examined	Not recorded	+	—	—	—	—	Moderate
6	120	8	3	Left mastoid, recurrent	2	M	Atropine 1/800	+	Moderate	1	+	+	Not examined			Moderate
7	90	Not recorded	3	Left mastoid	6	F	None	—	Moderate	2	+	+	+	—	—	Moderate
8	95	6	3	Left mastoid	8	M	Phenobarbital 1½ Atropine 1/250	+	Moderate	2	+	+	+	Not examined		Moderate
9†‡	120	5	3	Right mastoid, radical	23	F	Atropine 1/200	—	Scanty	0	+	+	+	—	+	Moderate
10	50	Not recorded	3	Right mastoid	3	F	Morphine 1/60 Atropine 1/800	+	Not examined	Not recorded	+	+	—	+	—	Moderate

11	70	Not recorded	5	Left mastoid	8	F	Morphine 1/24 Atropine 1/400	+	Not examined	Not recorded	+	+	Not examined	+	—	Moderate
12	45	Not recorded	3	Fibroma	20	M	Morphine 1/6 Atropine 1/150	—	Not examined	Not recorded	+	+	—	+	—	Scanty
13	75	9	3	Right mastoid	4	M	Atropine 1/400	—	Moderate	2	+	+	+	+	±	Moderate
14	80	12	3	Left mastoid	19	F	Morphine 1/6 Atropine 1/150	—	Moderate	0	+	—	+	Not examined		Scanty
15	100	11	3	Left mastoid	20	F	Morphine 1/6 Atropine 1/150	—	Profuse	3	+	+	+	+	±	Profuse
16	120	15	3	Right mastoid	6	M	Codeine sulphate 1/4 Atropine 1/300	+	Moderate	1	+	+	+	+	+	Moderate
17	90	9	10	Left mastoid	8	M	Morphine 1/12 Atropine 1/250	—	Scanty	0	+	+	+	±	+	Moderate
18	Not recorded	Not recorded	3	Mastoid	16	M	None	—	Not examined	Not recorded	+	+	+	+	+	Moderate
19	100	Not recorded	10	Left mastoid	20	F	Morphine 1/6 Atropine 1/200	—	Not examined	Not recorded	+	+	+	+	+	Moderate
20	80	10	3	Right mastoid	22	F	Morphine 1/6 Atropine 1/150	—	Moderate	3	+	+	+	+	+	Moderate
21	110	Not recorded	20	External frontal sinus	34	M	Morphine 1/4 Atropine 1/200	+	Not examined	Not recorded	+	+	+	+	+	Profuse
22*†	55	9	3	Laparotomy; vaginal repair	21	F	Morphine 1/4 Atropine 1/150	—	Scanty	0	—	—	—	—	—	0

* This patient, not included in the series, was operated on in the Trendelenburg position.
† Three grains of sodium amytal was given on the night before operation and 3 grains of phenobarbital two hours preoperatively.
§ Three grains of phenobarbital was given on the night before operation.
‡ Gas-ether anesthesia was employed.

per cent) of the 21 cases. The observations on topographic distribution are summarized in the accompanying table of case analyses (table 2).

This table shows the two principal groups—one group consisting of 4 cases without evidence of aspiration and the other of 17 cases with evidence of aspiration. The second group is then subdivided into the cases with aspiration into the larynx only (1 case); into the larynx and trachea (1 case); into the larynx, trachea and right bronchus (3 cases); into the larynx, trachea and left bronchus (3 cases); into the larynx, trachea and both main bronchi (3 cases), and into the larynx, trachea, both main bronchi and the bronchi of the inferior lobe (6 cases).

TABLE 2.—*Analyses of Cases in Respect to Extent of Aspiration*

Aspiration	Cases
No evidence of aspiration	1, 2, 3, 4
Aspiration	
Into larynx only	5
Into larynx and trachea	6
(Not possible to examine the lower respiratory passages†)	
Into larynx, trachea and right bronchus	7, 8
(Left bronchus not examined†)	9
(stained material also present in bronchi of right inferior lobe)	
Into larynx, trachea and left bronchus	10, 11
(Right bronchus not examined†)	12
Into larynx, trachea and both main bronchi	13, 14
(None seen in trachea*)	15
(Impossible to tell whether bronchi of inferior lobe contained secretion†)	
Into larynx, trachea, both main bronchi and bronchi of lower lobe	16, 17
(None seen in left main bronchus*)	18, 19, 20, 21

* In cases 14 and 17 stained aspirated material, although not seen in one segment of the tracheobronchial tree, passed through the segment and was noted lower down.

† In cases 6, 8 and 11 it was not possible because of difficulties in anesthesia, and in case 15, because of difficult visibility, to examine certain parts of the tracheobronchial tree. If it had been possible, any additional observations could have served only to add these cases to the groups showing more complete distribution of aspirated material.

The table also demonstrates that in the cases with aspiration the stained material was likely to be sucked into the whole bronchoscopically visible portion of the tracheobronchial tree rather than to be limited to one segment. As may be noted in each table, in several of the cases it was not possible to complete the bronchoscopic examination. In 3 cases the anesthesia was disappearing, while in a fourth case the lumens of the main bronchi were completely filled with foamy, stained fluid. If further examination had been possible, the additional observations could have served only in the direction of adding these cases to the group with the more complete distribution of aspirated material. In 2 cases stained fluid was seen lying beyond an unstained portion of the tracheobronchial tree. This suggests that aspiration may have been even more extensive than the data indicate, since unstained secretion may also have been aspirated.

Aspiration was demonstrable into the larynx in 17 cases (81 per cent); the trachea in 15 cases (71 per cent); one or both main bronchi in 15 cases (71 per cent); both main bronchi in 8 cases (38 per cent); one main bronchus in 7 cases (33 per cent), and the bronchi of the inferior lobe in 7 cases (33 per cent).

The estimated amount of stained aspirated secretion was scanty in 2 of the 17 cases, moderate in 13 and profuse in 2. The tables do not indicate a correlation between the topographic distribution and the quantity aspirated.

In this small group of patients no correlation could be discovered between aspiration and the various factors mentioned in the preoperative observations and in those made during the operation. In regard to the gag reflex, for example, of 8 patients in whom it was present at the time of the instillation of the dye, aspirated material was present in 6; of the 13 patients in whom the reflex was absent, aspiration occurred in 10. In regard to pharyngeal content, 1 patient with profuse pharyngeal content showed no aspiration, while 2 patients with scanty pharyngeal content showed aspiration. It is to be borne in mind, however, that the estimation of pharyngeal content was on an unsatisfactory basis. Aspiration occurred in some cases in which suction was used. On the other hand, in 1 case with profuse content in which suction was used twice, no aspiration was manifested. In 19 of the cases, the head and shoulders were turned to one side. Of 9 cases in which the turning was to the left, aspiration occurred in 7, with stained secretions on both sides in 4, on the left side only in 2 and on the right side only in 1. Of 10 cases in which the head and shoulder were turned to the right, aspiration occurred in 8, with stained secretions on both sides in 2, on the right side in 4 (in 2 of which the left side was not examined) and on the left side only in 1 (in which the right side was not examined), while in 1 case the bronchi were not examined, the secretion being present in the trachea. These data show that in this series no correlation was to be discerned between the turning of the head and shoulder to one side and special aspiration on that side.

The other factors—the duration of anesthesia and the quantity of anesthetic, the amount of dye instilled, the age and sex of the patient and the preanesthetic medication—showed no correlation with the aspiratory observations.

It would seem that the use of frequent or continuous suction is indicated in operations performed on patients under general anesthesia, in order to minimize the amount of secretion that can be aspirated. It is pertinent, in view of the observations, to state that because of the probability of aspiration the hygienic condition of the nose, mouth and pharynx should be investigated and rendered normal before any opera-

tive procedure under general anesthesia is undertaken, even though the operation is on a remote part.

In comparing the percentage of cases in which aspiration followed operations on parts not draining into the pharynx, performed with the patient under ether anesthesia, with that obtained from a review of the literature dealing with cases of aspiration following operations on the upper respiratory passages, also with the patient under ether anesthesia, it is found that there is no significant difference. In the series described here, aspiration occurred in 76 per cent of the cases, while in cases recorded in the literature aspiration occurred in from 62 per cent (Vail) to 79 per cent (Myerson). This percentage is about twice that shown by Iglauer for cases following tonsillectomy with the patient under local anesthesia.

If postoperative pneumonopathy is ascribable to aspiration during tonsillectomy, it is also probable that postoperative pneumonopathy may be the result of aspiration of saliva and pharyngeal content following other operations, even on remote parts. In this series there were no complications in the lungs.

SUMMARY AND CONCLUSIONS

1. The literature dealing with cases of postoperative pulmonary suppurative complications, especially of the aspiratory type, occurring in animals and in human beings, was reviewed from the experimental, clinical and pathologic points of view.

2. A bronchoscopic postoperative study was made in human beings in whom the pharyngeal content was not artificially increased by blood and aspiration was not made easier by manipulation of the tongue (as in tonsillectomy).

3. The data analyzed led to the following conclusions:

(*a*) In operations performed with the patients under ether anesthesia on parts which do not drain into the pharynx, with the patient in the supine (horizontal) position, aspiration of pharyngeal content into the tracheobronchial tree occurred in 76 per cent of the small series of cases studied.

(*b*) It was shown that either no aspiration occurs in a small proportion of cases (24 per cent) or aspiration takes place in a large proportion (76 per cent); when it does occur it is likely to involve the entire bronchoscopically visible portion of the tracheobronchial tree.

(*c*) There is no significant difference between the percentage of cases of aspiration in etherized patients with operations on the upper respiratory passages or pharynx (from 62 to 79 per cent) in the cases obtained from the literature and that in the cases in this series (76 per cent).

(*d*) Aspiration by etherized patients in this series and in the various series reported in the literature is twice as frequent as in patients undergoing tonsillectomy under local anesthesia.

4. Aspiration is important as an etiologic factor in postoperative pneumonopathy even in cases in which the operation is not on the pharynx, mouth or nose.

5. Frequent or continuous suction is suggested as a means of decreasing the amount of pharyngeal content subject to aspiration.

6. The hygienic condition of the mouth, nose and throat is an important factor, since on this depends the infectivity of aspirated material.

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Dr. Joseph Filger, assistant resident in otolaryngology, Cincinnati General Hospital, assisted with the bronchoscopies, and Dr. Josef D. Weintraub aided in analyzing the data.

A SURGICAL METHOD FOR THE PREVENTION OF THROMBOPHLEBITIS OF THE CAVERNOUS SINUS

REPORT OF A CASE

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BROOKLYN

Bacterial thrombophlebitis of the cavernous sinus secondary to an infection about the face presents a formidable problem. The difficulty of early clinical recognition of such a lesion, the anatomic position of the sinus and the knowledge that bacterial meningitis will probably occur are all factors that mitigate against succesful treatment of this disease. Attempts have been made to surmount some of these difficulties, but the reported results following the operative treatment of an infected cavernous sinus have not been encouraging.

We have been unable to find any record of an attempted surgical attack on the cavernous sinus prior to 1892. In this year Bircher [1] operated on a woman, 25 years of age, who had chronic suppurative otitis media of many years' duration. A temporal approach was used to expose the apex of the petrous part of the temporal bone, which was found to be necrotic. The suppuration extended into the posterior part of the cavernous sinus. The necrotic bone was removed, and a gauze drain was placed at the posterior end of the cavernous sinus. The patient recovered. In 1899, Dwight and Germain [2] exposed the cavernous sinus by means of an intradural temporal approach. The sinus was incised and some clotted blood evacuated, after which a piece of gauze was inserted as a drain. The patient died in a few hours following the operation. In 1900, Hartley [3] exposed the cavernous sinus by the temporal route, intradurally. He encountered what he thought was an aseptic blood

From the Neuro-Surgical Service and the Otolaryngological Service of the Kings County Hospital.

1. Bircher, H.: Phlebitis des sinus transversus, petrosus inferior und cavernosus. Eröffnung und Desinfektion nach Entfernung der Felsenbeinpyramide. Heilung, Zentralbl. f. Chir. **20**:483 (June 3) 1893.

2. Dwight, E. W., and Germain, H. H.: Thrombosis of the Cavernous Sinus with Report of Four Cases, Including One Cranial Operation, Boston M. & S. J. **146**:456 (May 1) 1902.

3. Knapp, H.: A Case of Primary (Traumatic) Non-Infected Thrombosis of the Cavernous Sinus: Operation (by Frank Hartley), Tr. Am. Ophth. Soc., 1900, p. 77.

clot, which on microscopic examination proved to be a sarcoma. The patient died three months later. In 1905, Luc [4] advocated the transantral route as a result of his anatomic studies. He proposed opening the anterior wall of the maxillary sinus on the side opposite the involved venous sinus, through which he would pass a curet to penetrate the wall of the sphenoid sinus and in this manner expose and drain the cavernous sinus. Langworthy [5] advocated the intranasal approach to the cavernous sinus. This was accomplished by means of a preliminary middle turbinectomy and the perforation of the anterior and lateral walls of the sphenoid sinus by a curet. The curet was then advanced so that it would enter the cavernous sinus. In 1912, Ballance and Hobhouse [6] operated on a patient in whom an infection of the cavernous sinus developed secondary to otitis media. By means of an external temporal approach, an incision was made into the cavernous sinus. Pus and blood were evacuated. A drainage tube was inserted into the cavity of the sinus. The patient died two days later. A year later Mosher [7] operated on a patient with clinical evidence of thrombophlebitis of the cavernous sinus. He approached the sinus by way of the orbit. After the orbital contents were removed, he enlarged the sphenoid fissure by cutting away part of the orbital plate. The patient did not recover. Mosher elaborated his report by studies on the cadaver, as a result of which he evolved what has since become known as the orbital approach operation. In 1926 Eagleton [8] reported his operation on a child who had thrombophlebitis of the cavernous sinus secondary to ethmoiditis. He followed the technic advocated by Mosher, but added ligation of the common carotid artery of the side of the lesion. His description of the operation follows: "Large Kroenlein osteoplastic flap of the outer wall of the orbit. Orbital contents eviscerated. Part of great wing of sphenoid removed. Cavernous sinus exposed with ophthalmic vein entering into it. Cavernous sinus opened and probe passed inward three quarters to one inch until stopped by petrous pyramid. No bleeding, no clot." The patient recovered. In 1929, Christophe [9] reported the case of a woman, aged 32, in whom

4. Luc, H.: La voie d'access vers le sinus caverneux, Bull. et mém. Soc. franç. d'otol. et de laryng. **21**:178 (May) 1905.

5. Langworthy, H. G.: Thrombosis of the Cavernous Sinus with Report of Four Cases, Boston M. & S. J. **156**:528 (April 25) 1907.

6. Ballance, C. A., and Hobhouse, Neil: A Case of Septic Thrombosis of the Left Sigmoid, Left Cavernous, and Left Inferior Petrosal Sinuses: A Suggestion for Treatment in Future Cases, Tr. Internat. Otol. Cong., 1912, p. 308.

7. Mosher, H. P.: The Orbital Approach to the Cavernous Sinus, Laryngoscope **24**:709 (Aug.) 1914.

8. Eagleton, W. P.: Cavernous Sinus Thrombophlebitis, New York: The Macmillan Company, 1926, p. 136, case 22.

9. Christophe, Louis: Thrombo-phlébite du sinus caverneux. Opération-guérison, J. de chir. et ann. Soc. belge de chir. **27**: 312 (Dec.) 1928.

signs of thrombophlebitis of the cavernous sinus developed following an infection of the upper jaw. He employed the technic which was advocated by Mosher and used by Eagleton. After the cavernous sinus was exposed, an opening was made into its lumen, and the thrombus was visualized but not removed. A drain was placed in contact with the thrombus. The patient recovered.

From this résumé of the literature one may say that up to the present time four routes of surgical approach to the cavernous sinus have been offered. These are: (1) the Hartley-Kraus route by means of a temporal opening and either an extradural or an intradural exposure of the sinus, (2) Mosher's anterior orbital approach with exenteration of the orbital contents and removal of part of the orbital plate, (3) the nasosphenoidal route of Langworthy and (4) the transantral route of Luc. All of these procedures have had as their objective incision and drainage of the sinus after it had become grossly infected. Because of the anatomic complexity of the cavernous sinus, it is questionable whether incision alone would alter the course of an infection within this structure.

The results of autopsy on two patients who had died from thrombophlebitis of the cavernous sinus and meningitis secondary to infection of the upper lip convinced us that an operation other than those already advocated should be developed. From our observations it was concluded that the logical method of treatment of an advancing infection of the face which had invaded the orbit and in all likelihood was destined to implicate the cavernous sinus would be to occlude the ophthalmic veins at their point of union with the cavernous sinus. Furthermore, it seemed evident that once thrombophlebitis had involved the cavernous sinus any surgical procedure would be of questionable value in curing the disease. The operation decided on was to expose the cavernous sinus in question through a temporal cranial opening and an intradural elevation of the temporal lobe of the brain. Following the visualization of the cavernous sinus (fig. 1), its most anterior arm was to be thoroughly coagulated with the electrocoagulating current. It was appreciated that a successful outcome could not be expected unless the operation thus advocated was performed immediately on clinical evidence of phlebitis of the orbital veins, namely, slight proptosis, unilateral partial fixation of the ocular bulb and early edema of the optic nerve head.

In due course a young man with a rapidly advancing infection of the face was admitted to the hospital. The following report gives the subsequent course of events and the final outcome.

REPORT OF CASE

H. M., aged 23, a clerk, was admitted to the Kings County Hospital to the surgical service of Dr. H. W. Benoit on April 25, 1932, with the complaint of a boil on the right side of his nose. He had enjoyed good health with the excep-

tion of pneumonia and empyema in 1926, from which he had completely recovered. On April 22, 1932, he first noticed a small red pimple just to the right of the tip of his nose, which increased rapidly in size during the next three days and assumed the appearance and proportions of a true carbuncle. On the day following admission the inflamed area was given roentgen treatment. The appearance of the carbuncle remained unchanged until the moring of April 28 (six days after the onset), when there were observed swelling of the right eyelids and slight prominence of the right eyeball (fig. 2). During the afternoon of the same day the patient complained of headache and a chilly feeling. When seen by one of us that evening there was a large, swollen, red area over the right half of the nose with several small discharging openings in its center. The edema and redness

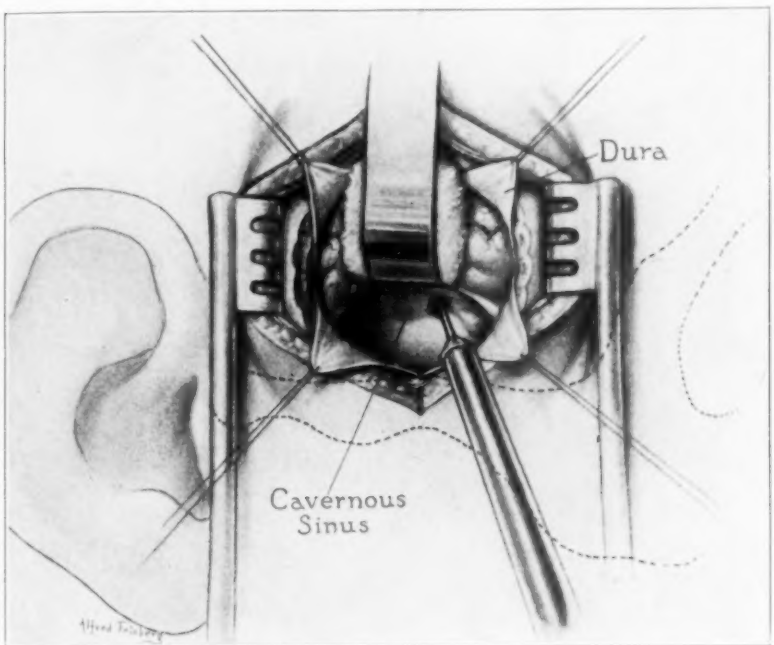


Fig. 1.—A drawing showing the exposure of the cavernous sinus and the method of coagulation.

extended along the course of the right angular vein to the medial aspect of the right lower eyelid. This eyelid was only slightly swollen. The upper eyelid, however, was edematous and had a smooth shiny surface with a bluish tint. The right ocular bulb was moderately proptosed, the conjunctivae being injected and edematous. The ocular movements were slightly limited on the affected side and normal on the left side. The pupils reacted promptly to light and in accommodation. The right fundus revealed dilated retinal veins with obliteration of the physiologic cup of the optic disk and edema over and about the nasal half of the nerve head. The left fundus was normal. The acuity of vision was not disturbed in either eye. The neck was slightly rigid, and a positive Kernig sign was present. Poorly sustained bilateral ankle clonus could be demonstrated. The temperature was only 100.6 F., but the patient appeared acutely ill. The blood count showed 19,600

white cells with 90 per cent polymorphonuclear elements and 10 per cent lymphocytes. A specimen of blood taken at this time subsequently showed the presence of Staphylococcus aureus. The same organism was cultured from the pus obtained from the carbuncle. The spinal fluid revealed 12 cells per cubic millimeter. No globulin was present. Culture of the spinal fluid showed no growth.

It seemed reasonable to believe that this was a favorable case for a trial of the operation which had been contemplated. Through a moderate-sized right subtemporal cranial opening the dura was incised, disclosing a mildly injected cerebral cortex. The pole of the temporal lobe was retracted and the sphenoid ridge exposed, which was followed down to the tuberculum sellae. The right half of the cavernous sinus was easily visualized because of its bluish color. The wall of the sinus was soft, and it was easily blanched by pressure. It was thought to be normal. By first coagulating the surface and then introducing the point of the

Fig. 2.—Appearance of the patient just before operation. The enlarged nose and the prominent eye are evident, although the picture is not clear.

needle into the most anterior aspect of the sinus, thorough obliteration of its lumen at this site was accomplished. Following complete hemostasis, the wound was closed with layer silk. At the end of this operation the right angular vein was incised and found to contain thick, creamy pus, a culture of which showed Staph aureus.

The following morning (April 29) the patient's general condition was good. His temperature was 102 F. The exophthalmos of the right eye was somewhat increased and the chemosis more marked. The patient complained of considerable pain in this eye. This bulb was absolutely fixed, the pupil was moderately dilated, and the patient could barely count fingers at a short distance. The fundus could not be observed because of the opaque intra-ocular media. There were no disturbances of cutaneous sensibility over the right side of the forehead. The left eye was normal. The neck was slightly stiff. Marked sweating was present.

For one week the temperature ranged between 99.6 and 102.4 F., while marked sweating continued. The blood culture on several occasions showed Staph. aureus, the white blood cells remained around 20,000 per cubic millimeter, and there was progressive proptosis of the right eye. The swelling became so great that it seemed as if the entire bulb would be extruded between the markedly swollen eyelids (fig. 3). Several incisions were necessary to evacuate the intra-orbital pus. The right cornea became ulcerated, and there was evidence of infection of the anterior chamber. Vision was lost in the right eye on the second post-operative day. The left eye remained normal.

During the second and third postoperative weeks, in fact up to May 21, there was profuse sweating. A sterile blood culture was obtained for the first time on May 11. The edema of the right eyelids and the proptosis were slow to

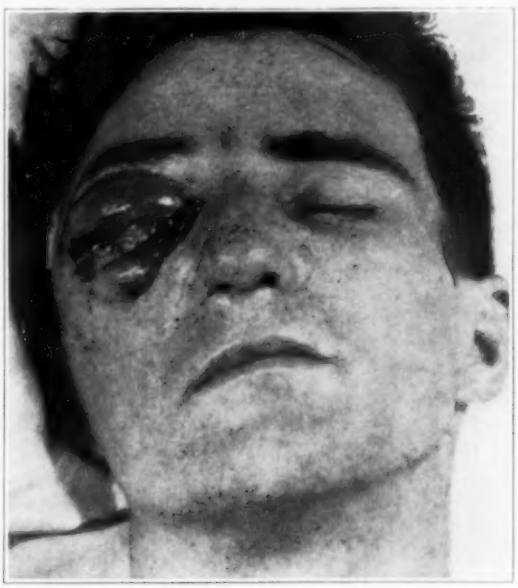


Fig. 3.—Appearance of the patient eight days following operation.

recede, while a great deal of pus continued to discharge from the several peri-orbital incisions. The offending organism showed a great predilection for veins, migrating along the course of the right temporal plexus. On May 24 the patient complained of pain in the right side of the chest, and physical examination revealed râles in this region. Roentgenographic examination of the thorax disclosed multiple healing metastatic abscesses, which probably explained the persistent sweating and, in part, the low grade fever. From this time on there was slow but progressive improvement until the patient's discharge from the hospital sixty-six days following the operation (fig. 4). At the time of discharge there was present corneal opacity on the right side with complete blindness of the right eye. The right upper lid was still slightly thickened. All the wounds were healed. The extra-ocular movements of the right eye were considered to be within normal limits, and there was no evidence of sensory disturbance over the cutaneous areas supplied by the first division of the right fifth cranial nerve.

Fig. 4.—Appearance of the patient fifty-three days following operation.

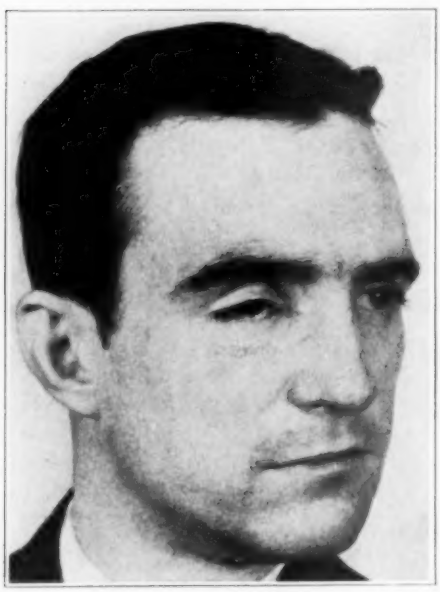


Fig. 5.—Photograph of the patient one year following operation.

Examination one year following the operation showed a normal young man with the exception of the right eye (fig. 5). At this time there was definite enophthalmos with ptosis of the upper lid and a slight tendency to entropion of the lower lid. The cornea was clear except at its most inferior central margin, where there was a small opacity. The iris was adherent at its lower margin. There were several cutaneous scars: one on the upper lid, one on the lower lid and one over the center of the supra-orbital ridge. The pupil of the right eye did not react to light either directly or consensually. The corneal reflex was intact. This eye was blind.

COMMENT

In this communication we are concerned only with thrombophlebitis of the ophthalmic veins secondary to an infection of the upper portion of the face or within the accessory nasal sinuses. By far the majority of such infections are not spontaneously limited to the orbit but advance to a fatal thrombophlebitis of the cavernous sinus and meningitis. As shown by the report of Dwight and Germain,[2] there are instances of spontaneous recovery from thrombophlebitis of the cavernous sinus. Fourteen recoveries were recorded in a collected series of one hundred and eighty-four cases by these authors. The portal of entry in this series was largely otitic. This indicates that in general a slowly advancing or so-called chronic infection of the cavernous sinus should be treated conservatively regardless of the avenue of invasion. On the other hand, the majority of the infections of the face that spread by the way of the ophthalmic veins to produce true thrombophlebitis of the cavernous sinus do so in an alarmingly rapid manner. The clinical manifestations of the rapid advance of such an infection change every few hours; consequently, if any success from the suggested operative procedure is to be expected, the operation should be performed as soon as there is definite evidence that the ophthalmic veins are involved in the thrombophlebitic process. There are instances in which such an infection advances so rapidly that any therapeutic measure seems useless, bacterial meningitis becoming evident within a few hours following the clinical indications that the orbital veins are implicated. A favorable outcome following this advocated operation rests not only on the technic of the procedure but on the choice of the case.

Fig. 6 shows clearly the logical area in which to produce an aseptic clot in an attempt to limit thrombophlebitis of the ophthalmic veins to the orbit. The point selected for coagulation and occlusion of the lumen of the ophthalmic veins lies at the superior orbital fissure and may be either approached from the orbital side by removing the orbital contents or preferably visualized through a clean intracranial exposure as the most anterior part of the cavernous sinus. By occlud-

ing this anterior part of the cavernous sinus as advocated, the cellular barrier to the orbital infection remains undisturbed.

As to the choice of cases, it is our opinion at the present time that this operation should be performed only in instances in which there is definite evidence of unilateral thrombophlebitis of the ophthalmic vein that shows progressive advancement but as yet has not invaded the cavernous sinus. (The absence of an increased cell count in a specimen of the spinal fluid would be sufficient indication that the cavernous sinus

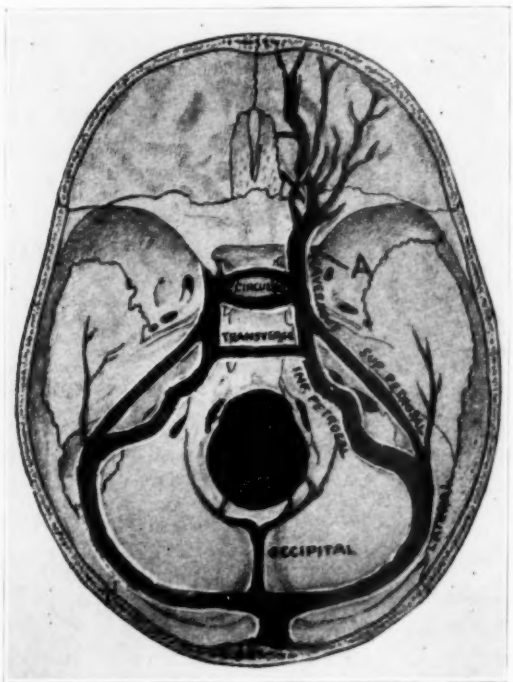


Fig. 6.—A diagram of the intracranial venous sinuses in the base of the skull with an arrow (*A*) indicating the site of election for the electrocoagulation.

was not infected.) Bilateral proptosis is a definite contraindication for this operation. From our experience with a single case we feel that electrocoagulation of the anterior arm of the cavernous sinus on the side of the orbital infection before thrombophlebitis of the cavernous sinus has developed will aid in the cure of an otherwise fatal infection. It is therefore essential that one recognize at an early period of this disease the pathway of the infection, take cognizance of the rapidity of its spread and operate before the cavernous sinus becomes implicated.

SUMMARY

The literature concerning the surgical approach to the cavernous sinus has been reviewed.

A case of thrombophlebitis of the ophthalmic veins secondary to a carbuncle of the nose has been recorded.

The patient was successfully treated by coagulating the anterior arm of the cavernous sinus by way of an intracranial approach, thereby limiting the infection to the orbit.

Clinical Notes

UNUSUAL MYXOMA OF THE PHARYNX

Report of Case in Which the Growth Developed Under Observation

PAUL B. MACCREADY, M.D., NEW HAVEN, CONN.

Mixed cell tumor of the type found in the salivary glands occurs frequently in the parotid region and occasionally extends into the pharynx. Cases of simple connective tissue tumor—fibroma, myxoma, etc.—likewise are frequent in the pharynx. However, a case of a large myxoma arising in the region of the parotid gland and extending into the pharynx is unusual enough to record.

REPORT OF CASE

History.—L. C., a white woman aged 54, entered the New Haven Hospital complaining of pain in the upper teeth on the right side of five years' duration. For two years prior to her admission she had been under the care of an internist for the treatment of myxedema. When she first presented herself to him, her chief complaint was neuralgia of three years' duration in the upper teeth and on the right side of the face. This distress was fairly constant so that she was never entirely free from it, and it had been gradually growing worse. The pain was localized in the roof of the mouth and spread to the central incisors and to the bridge of the nose. At about the time the neuralgia started, the patient passed through the menopause. For the two years prior to admission, the patient had felt cold and chilly. She was tired all the time and wanted to sleep constantly. She had lost 20 pounds (9.1 Kg.) in the past three years. She noticed that she never perspired and that her skin scaled easily. About one month before the first examination she fainted, and since then she had had severe headaches. There were no visual disorders. She had complained of tinnitus in both ears when lying down. Her speech was normal.

During the last two years, the patient had been under constant supervision and had been treated principally with thyroid extract for myxedema. Nothing seemed to relieve the neuralgic pain.

Three months before admission a cold in the head developed, which was followed by the appearance of a swelling below the right ear. Associated with this condition there had been a feeling of fulness in both ears, which subsided with the cold. For two months the patient noticed the swelling but apparently had no symptoms referable to it. For the past month she had realized that the swelling had been increasing in size. During the past two weeks she had noticed a feeling of fulness in the throat on the right side.

Physical Examination.—The first physical examination was made two years before the patient's admission to the hospital. It showed

From the Department of Surgery, Yale University School of Medicine.

that the skin was dry and loose and revealed evidence of loss of weight. The eyebrows were thin; the axillary hair was scanty, and there were no pads of fat. Some fulness was noted over the thyroid gland, which was readily palpable. The retinal arteries were slightly sclerotic. The patient's heart showed no abnormality. The pulse rate was 84; the blood pressure measured 120 systolic and 70 diastolic. The lungs and abdomen showed no abnormality. Both the deep and the abdominal reflexes were somewhat diminished. The blood count revealed slight secondary anemia. The basal metabolic rate was minus 7 per cent. Roentgenograms of the skull showed nothing abnormal except a calcified plaque in the frontal region on the right side.

The clinical diagnosis was hypothyroidism and myxedema.

The results of another examination made one month before admission were essentially the same except that the basal metabolic rate was minus 13 per cent. The blood count still showed slight secondary anemia. There was some swelling beneath the ear on the right side (to be described later), but nothing abnormal was noted in the pharynx.

Examination of the Head at Time of Admission.—There was a definitely noticeable swelling slightly below and in front of the right ear, which caused the right cheek to appear fuller than the left. After palpation it was believed that this swelling was not part of the parotid gland but was due to a large gland the size of an English walnut behind, and just above, the angle of the jaw. The swelling was relatively soft—softer than a tuberculous gland ordinarily is. Below this gland and in the posterior triangle were two slightly enlarged, palpable glands of about the same degree of firmness. No glands could be palpated on the left side. The eyes, ears, sinuses, nose and teeth were essentially normal. On examination of the throat, the right tonsil appeared about twice the normal size, and the soft palate above it was pushed forward. Superficially, this condition resembled quinsy, but there was no edema, induration, pain on pressure or difficulty in opening the mouth. The left tonsil appeared large for a person of the patient's age, but otherwise it was not remarkable.

A nasopharyngoscopic examination showed bulging of the lateral wall of the nasopharynx and gave one the impression of tissue pressing against the eustachian orifice on the right side. My opinion was that while the diagnosis of a mixed tumor of the parotid gland could not be excluded, it did not seem probable. It seemed more likely that one was dealing with an early lymphosarcoma of the tonsil which could be verified on the basis of a biopsy. Considering the unusual appearance of the throat, it was believed that biopsy material could be obtained as readily by the removal of the right tonsil as by the excision of the gland by the external approach.

Operative Procedure.—The operation was done with the patient under nitrous oxide-ether anesthesia. A Sewall-Davis mouth gag was used, which gives complete exposure of the operative field as well as makes it possible for the ether to be carried directly to the pharynx. The right tonsil was easily excised by the dissection method, first described by Crowe, and appeared essentially normal after its removal. However, on removal of the tonsil, a smooth, soft mass, the size of an English walnut, was noted extending into the tonsillar fossa. Further dissection revealed that this mass was an encapsulated tumor. Pressure on the external

mass below the parotid gland elicited the fact that the mass extending into the tonsillar fossa was the inner end of the mass protruding externally. A large part of the tumor having been dissected out from the inside by blunt finger dissection, it was thought best to attempt the removal of the whole tumor from this approach rather than through an external incision. Only blunt finger dissection was used because of the danger of injury to the internal carotid artery. The tumor was completely encapsulated. It did not appear to be attached either to the parotid gland or to the mandible. During the course of the operation the capsule of the tumor was broken, but this did not interfere with the complete removal of the tumor and its capsule. A gauze plug was

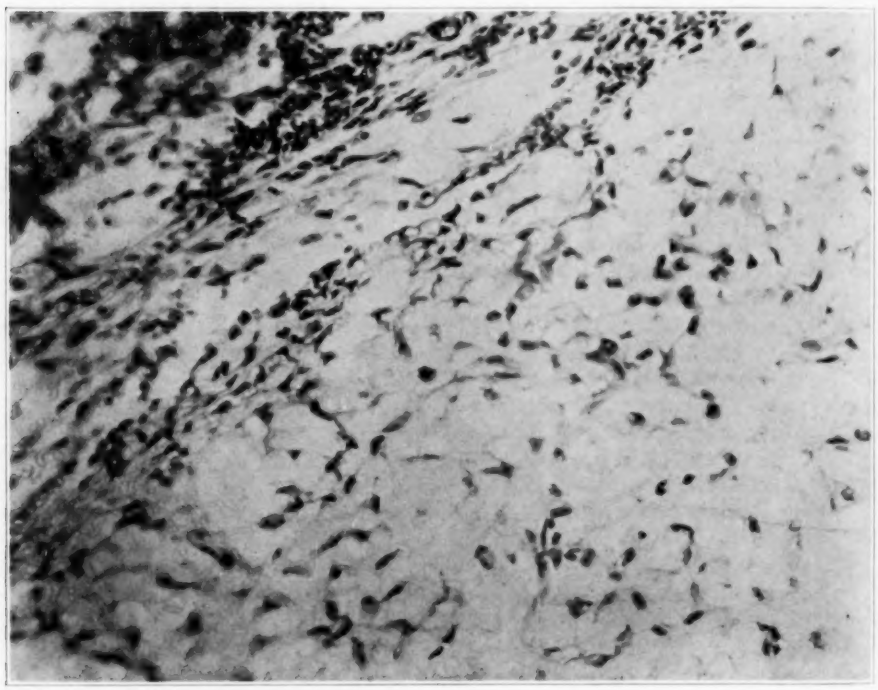


Fig. 1.—Most of the tumor is composed of myxomatous tissue, as shown in the lower half of the section. Near the capsule the cells are more compact. Magnification, × 200.

placed in the cavity of the tumor and removed at the end of twenty-four hours. There was no special trouble with hemorrhage. The patient made an uneventful recovery from the operation.

Following the operation the patient was in the hospital for ten days. She received radium therapy on the fifth postoperative day because the capsule of the tumor was broken during removal. The therapy consisted of the application of a radium pack to the neck externally and cross-firing the rays through three portals of entry. One portal was over the right side of the neck and antrum; the second, posterior to the angle of the jaw and the third, over the left tonsil. One hundred

per cent erythema doses and an exposure with the radium pack of 115 millicurie hours were used. The emanations were given at a distance of 3 cm. from the skin through a filter of 1 mm. of brass and 0.5 mm. of silver. The radium was applied for eighteen hours.

The patient had considerable pain and discomfort over the right cheek following the treatment, but during her stay in the hospital the temperature remained normal.

Postoperative Course.—One month after the operation the patient appeared to be in excellent condition. The swelling of the face had entirely subsided. The sense of taste, which had been disturbed, had returned. The throat was entirely healed.

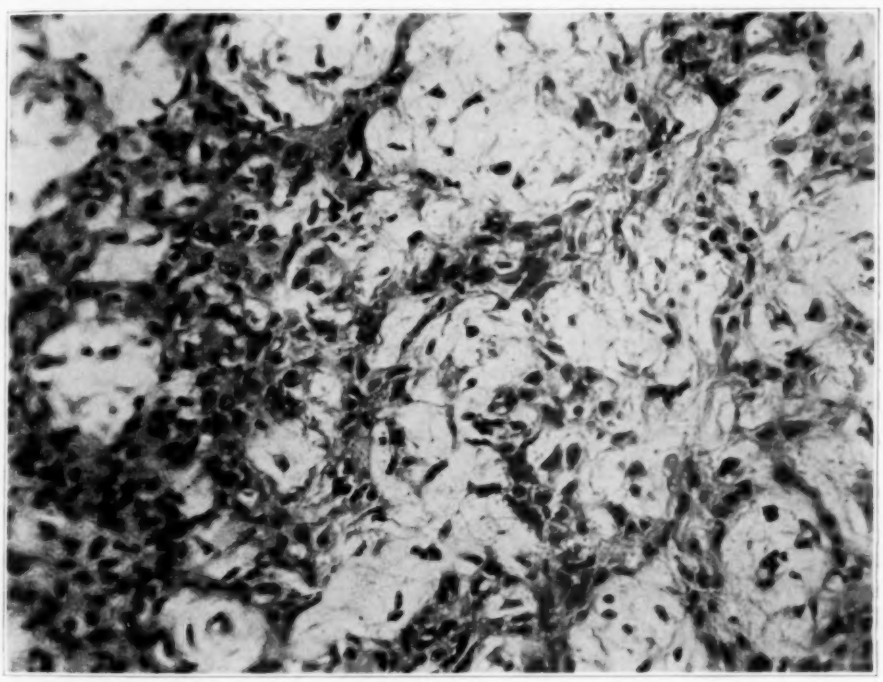


Fig. 2.—Many areas similar to that in this section were observed. The compact cells give the appearance of degenerating into myxomatous material. The vascularity is much greater in these areas. Magnification, × 200.

Two years after the operation the patient returned for observation. There was no evidence of swelling of the face. The throat appeared normal except for a large scar. The general condition was much better. The neuralgia of the teeth which had originally brought the patient to the hospital was still present, but it was much less marked and not disturbing.

Pathologic Examination.—The tumor was about 2 inches (5 cm.) long by 1 inch (2.5 cm.) in diameter and was completely encapsulated. It was relatively soft and lobulated. The capsule was broken, and a large amount of friable, yellowish-gray, mucoid or gelatinous-like

material had been squeezed out. Sections were made through many parts of the tumor to be sure that all the types of tissue were examined.

Microscopically, the majority of sections showed a tissue composed of thin, spindle-shaped cells that contained blue-staining, vesicular nuclei, which were either oval or elongated. The cells were loosely arranged with processes anastomosing and disappearing in the matrix. There were large masses of pale-staining, edematous-like material throughout the tissue. No collagen was present. In various zones the appearance differed somewhat, depending on the amount of edematous-like material. There were large areas which were myxomatous in appearance. Other zones contained compact, elongated cells with oval, blue, vesicular nuclei in which the compact cells appeared to be degenerating into myxomatous material. In these areas there were great vascularity and hemorrhage. Near the periphery the cells appeared more compact. The mass of tissue was encapsulated by a thin capsule of fibrous connective tissue.

The diagnosis was myxoma.

COMMENT

The patient had been under frequent observation before any signs of the tumor were present. The neuralgic pain in the upper teeth greatly antedated the appearance of the swelling. It was doubtful if this symptom indicated the beginning of formation of the tumor, though, undoubtedly, the pressure from the tumor greatly aggravated the neuralgia. The tumor apparently developed rapidly (three months?). The swelling was first noticed in the parotid region, and it did not extend into the pharynx until later.

Apologies need to be made for the type of operation used in removal of the tumor. Probably it would be far safer to remove a tumor in this position through an external incision. The operation was begun as a diagnostic procedure but was completed as the safest method under the circumstances. Possibly in some of the cases reported in the literature in which tumors of the mixed cell type have been removed by this route the operation was begun with the same idea of its being a diagnostic procedure.

A NEW DRUG FOR TREATMENT OF THE EUSTACHIAN TUBE AND MIDDLE EAR, WITH AN APPARATUS FOR ITS USE

EARL LEROY WOOD, M.D., NEWARK, N. J.

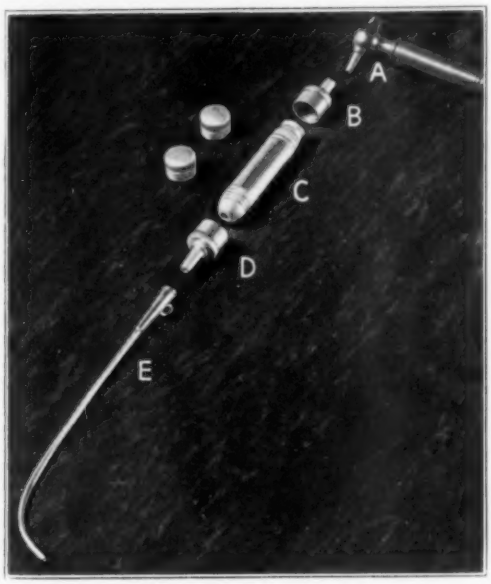
Otologists have long recognized the necessity and desirability of treating the eustachian tube in varied conditions. The majority of such treatments have been mechanical, although numerous medicaments have been applied locally. This has been accomplished directly by means of applicators or by blowing liquids into the tube through a eustachian catheter.

Solutions, owing to many obvious disadvantages, have not continued in wide use and have been abandoned in favor of vapors which are blown into the

eustachian tube to inflate both it and the middle ear. Vapors of iodine, ether, chloroform, menthol, camphor, etc., have been used sometimes in heated air. The action of these vapors on the living mucosa has been, for the most part, to increase the vascularity of the part treated.

Until recently no vapor was available which was capable of decreasing the congestion of the lining of the eustachian tube and the middle ear. The vapor of benzyl methyl carbinamine (benzedrine N. N. R.) has been shown to have a shrinking and decongesting action on the nasal mucosa.[1] The same action might reasonably be expected in the lining of the eustachian tube.

With this in mind, adaptors were made to fit the benzedrine inhaler onto a standard eustachian catheter so that the vapor could be easily introduced into



Instrument for the application of the benzedrine vapor to the eustachian tube and middle ear.

the eustachian tube. As shown in the illustration, these simple attachments (*B* and *D*) screw onto the ordinary benzedrine inhaler (*C*) after the caps are removed; the usual eustachian catheter (*E*) is fitted to one end, and the other end is joined to the air supply attachment (*A*), whether it is a Politzer bag, an atomizer bulb or an air pressure pump. When circumstances require, these attachments enable the physician to treat the eustachian tube and the middle ear in the patient's home and without the elaborate equipment used in the office.

With these attachments, benzedrine vapor was given a trial clinically in the treatment of the eustachian tube and middle ear of a large number of patients.

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1. Bertolet, J. A.: M. J. & Rec. **136**:75 (July 20) 1932. Byrne, H. V.: New England J. Med. **209**:1048 (Nov. 23) 1933.

It was found that the presence of benzedrine vapor caused no discomfort and increased and augmented the distending action of air alone. Benzedrine vapor, therefore, is suggested as a therapeutic adjunct in those cases in which inflation by means of a eustachian catheter is indicated to increase or to maintain the patency of the eustachian tube.

For general use in the office in cases of common nasal conditions the inhaler can be used with the air supply attachment for blowing benzedrine vapor into the nostril.

SUMMARY

The beneficial effects of benzedrine vapor in the eustachian tube and middle ear are suggested. Attachments for use with the benzedrine inhaler and ordinary eustachian catheter and air supply are described.

172 Roseville Avenue.

AN AUTOMATIC LIGATING NEEDLE FORCEPS

FERRIS SMITH, M.D., GRAND RAPIDS, MICH.

The automatic ligating needle forceps shown in the accompanying illustration is useful for the simple and rapid ligation of the posterior ethmoid and sphenopalatine arteries.[1]

An automatic ligating needle forceps.

The catgut suture is held in a slotted needle. Closure of the alligator jaw supporting the needle carries the suture through the tissue, and it is grasped in the spring eye of the fixed blade. The jaw is opened, and the end of the suture is drawn to the outside of the orbital or nasal cavity. The knots are tied externally and pushed into place with a ring knot tier.

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1. Smith, Ferris: Management of Chronic Sinus Disease, Arch. Otolaryng. **19**:157 (Feb.) 1934.

REMOVAL OF A FOREIGN BODY FROM THE NOSE OF AN INFANT

E. E. Carl, M.D., Milwaukee

Surgeons who have experienced the difficulty and worry of attempting to remove foreign bodies from the nose of babies and young children will appreciate a suggestion that may assist in the operation.

An assistant holds the head of the child. A ring of gauze is placed around the child's mouth. Both sides of the nose are closed by pressure, the child being forced to breathe through the mouth. After the surgeon takes a long breath he quickly places his mouth over the patient's mouth, on the gauze ring, and at the same time the pressure on the side of the nose containing the foreign body is released. An effort is made to blow hard into the child's mouth, thus forcing the air out of the obstructed side of the nose. It is well to have some gauze held between the child's nose and the surgeon's face to catch the discharge from the patient's nose when the air is forced through.

A parent may be instructed how to do the blowing.

Since the trachea itself is involuntarily blocked by the struggling child, the only outlet for the air is through the nostril.

Progress in Otolaryngology

A Summary of the Bibliographic Material Available in the Field of Otolaryngology

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ANATOMY AND PHYSIOLOGY OF THE EAR

PHILIP E. MELTZER, M.D.
AND
CHARLES N. GETTES, M.D.
BOSTON

(*Concluded from page 486*)

VESTIBULAR PHYSIOLOGY

Le Heux and de Kleijn [30] studied the influence of unilateral extirpation of the labyrinth in cats on the movements of the alimentary canal. In the first series of experiments bilateral vagotomy was performed and after the animals had entirely recovered the movements of the alimentary canal were carefully studied by means of roentgenograms after the method of Cannon. Some time later unilateral extirpation of the labyrinth was performed, and the following day the gastro-intestinal movements were again examined. In a second series of experiments exactly the same examinations were made, the only difference being that instead of the vagus nerve the sympathetic nerves of the alimentary canal were cut.

The authors summarize their observations as follows:

> After labyrinth-extirpation in cats the reflexes which govern the movements of the alimentary canal, pass for the most part or even entirely along the vagi. If both the vagi are cut before the labyrinth-extirpation, the latter operation no longer causes disturbances in the movements of the alimentary canal.
>
> The elimination of the sympathetic innervation of the alimentary canal from the stomach to the caecum by cutting the postganglionic fibers in their course, does not neutralize the influence of the labyrinth-extirpation.

In all of their examinations the authors found that:

> Labyrinth-extirpation was followed by a diminished emptying of the stomach, a delayed filling of the large intestine and a typical change in the curve which indicates the total length of the shadow of the small intestine. Our conclusion, therefore, is that, in principle, exactly the same phenomena were found to occur after labyrinth-extirpation in normal animals, as in animals in which the sympathetic innervation was abolished.

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30. LeHeux, J. W., and de Kleijn, A.: Influence of Unilateral Labyrinth-Extirpation in Cats on the Movements of the Alimentary Canal, Proc. Roy. Soc. Med. **26**:1580 (Oct.) 1933.

Following the lines of the studies of Spiegel, Baglioni, Amantea and others, Aronson [31] investigated the conduction of the labyrinthine impulses to the cortex. By placing strips of filter paper impregnated with a 1 per cent solution of strychnine on the posterior ectosylvian and suprasylvian gyri in cats and dogs and then stimulating the labyrinth by rotation, he was able to produce epileptiform convulsions. Even after deduction of one labyrinth and strychninization of the aforementioned cortical areas, first on the same and then on the opposite side, rotation still produced convulsions. From these experiments he concludes that each labyrinth is connected with the contralateral as well as with the homolateral portion of the cortex. After total severance of the posterior longitudinal fasciculus, rotation still caused convulsions under the influence of strychninization. At no time during the experiments were the animals given an overdose of strychnine. Aronson concludes, therefore, that labyrinthine impulses reach the cortical centers not only by way of the posterior longitudinal bundle but by other tracts.

In studies published in 1929 and 1933 Spiegel and Teschler showed:

> . . . the vestibular nuclei play an important rôle in the cortical control of the lateral eye movements. Bilateral injuries of the vestibular nuclei change the direction of the movements of the eyes that are elicited by electrical stimulation of the frontal lobe and of the occipital lobe. Whereas stimulation of these cortical areas usually produces conjugate lateral movements to the opposite side, such stimulation yields chiefly vertical deviation of the eyes, if the vestibular nuclei on both sides have been previously injured.

After continuing these experiments on cats, Spiegel and Aronson [32] summarize their work as follows:

> 1. The cortical centers of eye movements were stimulated after unilateral labyrinthectomy, during Bechterew's compensatory nystagmus, and during caloric stimulation of the labyrinth.
>
> 2. The interference of the spontaneous nystagmus after loss of one labyrinth, as well as of Bechterew's nystagmus, with cortical impulses which tend to move the eyeballs in the opposite direction, eventually results in clonic eye jerks in the direction of the nystagmus, toward the stimulated cerebral hemisphere instead of toward the resting hemisphere.
>
> 3. In caloric stimulation of the labyrinth, the vestibular reaction was weaker than the cortical, the corticofugal impulse suppressing a nystagmus toward the stimulated hemisphere.
>
> 4. It is assumed that the interference of the corticofugal with the labyrinthine impulses takes place within the vestibular nuclei.

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31. Aronson, L.: The Conduction of Labyrinthine Impulses to the Cortex, J. Nerv. & Ment. Dis. **78**:250 (Sept.) 1933.

32. Spiegel, E. A., and Aronson, L.: The Interaction of Cortical and Labyrinthine Impulses to Ocular Muscle Movements, Am. J. Physiol. **109**:693 (Oct.) 1934.

Spiegel [33] has shown in his previous work that the labyrinth is represented in the cortex and that its cortical localization is to be sought in parts of the temporal lobe. While there is an abundance of literature dealing with the effects of sensory impulses on the electrical potentials of the cortex, so far as Spiegel has been able to ascertain the electrencephalogram (the term was first used by H. Berger for the graphs of the cortical potentials) in stimulation of the labyrinth has not been studied. The chief question that he wished to answer was whether the electrencephalogram of the resting brain is changed if the labyrinth is stimulated by rotation. The next problem was to make an analysis to determine whether the electrical disturbances which are led off after rotation are really due to an excitation of the cortex. His summary after careful experimentation is as follows:

> The changes of electrical potentials induced in the cortex by stimulation of the labyrinth were studied. Rotation increased the currents, which were led off from the dorsal part of the posterior suprasylvian and ectosylvian gyri in cats under curare paralysis or bulbocapnine catelpsy. Such an effect was not prevented if the eyes were closed, the vagi or the uppermost segments of the spinal cord were severed, or the frontal lobe with the motor zone or the parietal lobe was extirpated. In deep ether anesthesia, after bilateral labyrinthectomy or after an incision into the white matter severing the connection of the posterior suprasylvian and ectosylvian gyri with the subcortex, the electrogram of these gyri was not changed by rotation. A postrotatory increase of the potentials in the parietal lobe depends on the intactness of the posterior suprasylvian and ectosylvian gyri and of the frontal lobe; after combined extirpation of the frontal and the temporal lobe, rotation could no longer increase the currents led off from the parietal lobe. Postrotatory electrical disturbances were noticed in the frontal lobe even after extirpation of the temporal lobes, but a definite effect of the rotation was no longer observed if this extirpation was combined with high transverse section of the spinal cord. The experiments seem to indicate that labyrinthine impulses can enter the cortex, particularly parts of the temporal lobe near the parietal lobe. It is also possible that the rubrothalamofrontal tracts are used as a common path by the labyrinthine as well as by other impulses. Further experiments on monkeys are planned to elucidate this point.

Spiegel and Aronson [34] in a study of the continuous stimulation of the labyrinth conclude:

> 1. Continuous caloric stimulation of the labyrinth can produce nystagmoid movements of the eye which appear, interrupted by short periods of rest, for several hours. Spontaneous nystagmus following extirpation of one labyrinth is lowered in its frequency by continuous stimulation of the opposite labyrinth with cold water.
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> 2. The direction of this nystagmus is, in the majority of cases (calorization of the external or of the middle ear), influenced by the position of the head, but in

33. Spiegel, E. A.: Labyrinth and Cortex: The Electrencephalogram of the Cortex in Stimulation of the Labyrinth, Arch. Neurol. & Psychiat. **31**:469 (March) 1934.

34. Spiegel, E. A., and Aronson, L.: Continuous Stimulation of the Labyrinth with Sustained Nystagmus, Arch. Otolaryng. **17**:311 (March) 1933.

some cases of calorization of the middle ear such an influence of the position of the head was not noticed.

3. It is assumed that the reaction of the labyrinth was due, in the first mentioned group, to an endolymph flow, whereas in the second group the calorization had finally acted on the end-organ itself.

4. The labyrinthine reflex arc reacts not only to caloric stimuli, but also to constant galvanization, with a tendency toward periodic fluctuations of its excitability.

For the past twelve years Lorente de Nó [35] has been conducting experiments for the purpose of determining whether the general plan of structure of the nervous system is represented by the unidirectional transmission system or by circuits. Using the Golgi and Cox methods he has conducted experiments on the first segment of the cervical portion of the cord, medulla oblongata, cerebellum, midbrain, thalamus and cerebral cortex; special attention was paid to the trigeminal system, which is homologous with the spinal cord, the acoustic system, which besides reflex arcs mainly contains pathways conducting sensory impulses, the vestibular system and the reticular substance, which is composed of internuncial relays.

The present study is concerned with the modification of the ocular reflexes after destruction of one or several parts of the vestibular system. In previous works Lorente de Nó has revealed the normal characteristics of the reflexes and has shown:

. . . the customary concept of the reflex arc is insufficient because it does not take into account two fundamental elements, the cells with short axis-cylinders and the recurrent fibers (collaterals of the axons and centrifugal fibers). These two elements were thought of as existing only in special cases, but when sought by these methods they have been found everywhere. Since the impulses that travel down the axis-cylinders pass into all the collateral branches, it follows that the transmission systems are made up of complicated circuits, which always are of one of the two types.

When the vestibulo-ocular arc was analyzed anatomically, there were found in the vestibular nuclei numerous hitherto unknown types of cells with short axis-cylinders. The extremely numerous fibers from the vestibular nuclei to the reticular substance were identified and the recurrent collaterals from the reticular substance and secondary vestibular paths to the primary vestibular nuclei are described. Lorente de Nó says:

The experiments demonstrate that the numerous pathways between the vestibular nuclei and the motoneurons are always being used at the same time and that, therefore, the reflex reactions are not determined in one nucleus, but rather are the consequence of the interaction of all the nuclei and the paths of the whole

35. Lorente de Nó, R.: Vestibulo-Ocular Reflex Arc, Arch. Neurol. & Psychiat. **30**:245 (Aug.) 1933.

vestibular system. It must be considered not only that the peripheral labyrinth is a physiologic unit, but also that its centers constitute a functional unit. . . .

Nystagmus is nothing else than an alternating reflex similar to other known rhythmic reflexes. The peripheral labyrinthine stimulation sets into activity a machinery which gives rise to nystagmus in the same way as the spinal cord sets up the scratch reflex as a response to a stimulus produced in the skin. Several experiments have led to the conclusion that the production of the rhythm of the nystagmus, i. e., of the quick component, needs more neurons than those used in the production of the slow component. These additional neurons lie in the reticular substance. . . .

The reciprocal innervation of muscles is conditioned because only the motoneurons of one muscle of the pair receive excitatory impulses; the motoneurons of the antagonistic muscle come to a state of rest. . . . When the internuncial relays or simple secondary pathways are destroyed, antagonistic muscles may show co-contraction, which again is changed into reciprocal innervation when still more internuncial relays are destroyed.

The uncrossed as well as the crossed secondary vestibular paths carry excitatory impulses.

In the vestibular system there is no "localization" of reflexes in anatomic nuclei; the whole system is a functional unit; reflex reactions may be produced as long as the reflex arc is closed through one of the multiple pathways; on the other hand, lesions in any part of the vestibular system modify all the reflexes.

Lorente de Nó [36] in an article on the interaction of vestibular reflexes states:

The contradiction between the old view (Bárány, 1917) and Ohm, 1919, that each semicircular canal acts on that pair of muscles that moves the eye in its plane and the fact that each canal sets up nystagmus in every muscle is now lessened by the conception of the reflex pattern as constituted by a nucleus and an appendage. Generally speaking it can be said that the nucleus of the reaction is constituted by the nystagmus of those muscles which in every case is necessary to produce an eye motion in the plane of the rotation of the head, while the appendage is constituted by those reflexes which in each case are necessary chiefly for furnishing the eye with a fixed axis of rotation (Lorente de Nó, 1932).

He summarizes his conclusions as follows:

1. The reflexes set up by stimulation of the cristae of the semicircular canals have been recorded simultaneously from the six eye muscles.

2. The reflex pattern set up by individual stimulation of a crista has two parts: a reflex nucleus that cannot be reversed by other concurrent stimulations and a reflex appendage in which reversals may take place.

3. Two stimulations are to be considered as antagonistic only when the nuclei of their reflex patterns are of opposite direction. When pitted against each other algebraic summation takes place and if both are of the same intensity no motor response appears.

4. Two stimulations are antagonistic when their nuclei are not opposed, although the nucleus of each one may be opposed to the appendage of the other. When pro-

36. Lorente de Nó, R.: Reflex Reversal and Interaction of Allied Vestibular Reflexes, Am. J. Physiol. **105**:122 (July) 1933.

duced concurrently their effects add quantitatively at the same time that in the appendages reversals take place so that in the resulting reflex pattern appear the reflex nuclei of both and an appendage that belongs to the stimulus to which it is more tightly bound.

5. The reflex reversal indicates the adaptation of a reflex pattern to pre-existing conditions; the nucleus remains unchanged but the appendage is modified. It is important to note that the amplitude of the reflex of all the muscles belongs to the appendage, i. e., to that part of the pattern susceptible of reversals.

The mechanism of production of the reflex reversal is discussed; in accord with previous work it is concluded that the reflex arc must inclose several internuncial neurons.

McNally and Tait,[37] in a comprehensive study of the action of the vertical canals in the frog, utilized a method whereby each canal could be ablated by severance of the ampullary nerve external to the membranous labyrinth. With the group of four vertical canals all possible ablatory selections and combinations were effected. The success of the various operations was checked both by gross and by microscopic examination. The results are tabulated as follows:

1. Removal of any single vertical canal documents itself in some disturbance of behavior during ordinary, quiet, forward crawling.

2. Sudden tipping of the frog toward the part of the body corresponding to an ablated ampulla causes extension of both limbs on the side opposite the functionless canal, with concomitant active flexion of one (or both) limbs on the side of this canal.

3. Ablation of a diagonal pair of canals produces unusually severe disturbance of gait. The animal is unstable not only during progression but also when it is tipped on a tilt-table.

4. By means of the chin lift and chin drop tests one is able to recognize immediately any mere uncomplicated lesion of one or more of the individual vertical canals, and in each case to specify the particular canal or canals involved.

5. Any lesion of a single vertical canal is apt to affect the ultimate stationary posture of the frog.

6. After a double anterior ablation the tone of the extensor muscle of the neck of the frog is defective. After double posterior ablation the tone of the flexors of the neck is similarly impaired.

7. The variety of labyrinthine tonus, as affecting the capacity of the relevant muscles to act quickly, is derived from the canals and depends on or consists of simple, flicklike muscle pulls applied at the proper moment.

37. McNally, W. J., and Tait, J.: Some Results of Section of Particular Nerve Branches to the Ampullae of the Four Vertical Semicircular Canals of the Frog, Quart. J. Exper. Physiol. **23**:147 (Aug.) 1933.

8. Ablation of two anterior canals, of two posterior canals or of two canals of the same side does not give rise to pendular swinging movements of the body. The functional antagonist of one anterior canal is the diagonally opposite posterior canal, and vice versa. Only when a pair of antagonists is removed does pendular oscillation occur.

9. When all four vertical canals are removed, the frog on any attempted movement is apt to show heavy pendular oscillation of the body. On a tilt-table it responds perfectly if tested slowly. In making each new correction, however, its head and body may exhibit minor pendulation.

10. When three vertical canals are ablated, three residual poses may be observed, two being diagonally forward or backward, corresponding to the plane of the ablated diagonal pair, and the third being either symmetrical groveling or a high symmetrical up-squatting, depending on whether the animal has lost a pair of anterior or a pair of posterior canals.

11. The nerve supplying the crista of an anterior canal branches like a Y externally to the membranous ampulla; one branch supplies one end of the cristal ridge, the other branch, the other end. Whichever branch is cut, the result is practically the same.

12. Whereas the functions of the horizontal canals and the utriculus may be complicated by concomitant vision, it is doubtful whether concomitant vision affects muscular responses to stimulation of the vertical canal.

McNally,[38] continuing his excellent work on labyrinthine physiology, presents the physiology of the vertical semicircular canals in the light of recent work. He stresses the importance of the vertical semicircular canals in controlling the normal tone and posture of the head, especially during movement. He infers that in the intact animal all six canals may be concerned in any movement and are necessary for its normal completion. The reaction from a normal vertical canal is immediate and so designed as to maintain the head in the horizontal plane.

In 1892 Ewald pointed out that the labyrinth exerts a tonic effect on the musculature of the body. Subsequent workers, chiefly Magnus (1924), localized this tonic effect to the otolithic part of the labyrinth. Tait and McNally, however, later demonstrated that both the canals and the utricles are concerned in the maintenance of normal labyrinthine tonus. They accomplished this by eliminating first one vertical canal and observing the homolateral loss of tonus in that portion of the head. When both canals were removed the frog sat with its head down, in contradistinction to the effect of removal of the posterior semicircular

38. McNally, W. J.: The Vertical Semicircular Canals in the Light of Recent Work, Ann. Otol., Rhin. & Laryng. **42**:82 (March) 1933.

canals when it sat with its head cocked up. When all four vertical canals were removed in an otherwise intact frog, it swayed or stumbled backward or forward or from side to side. These experiments showed striking evidence of the fact that the vertical semicircular canals are constantly being called on during any movement to maintain the head in the normal steady horizontal position.

When the utricles together with the vertical canals were removed, the dipping and oscillatory movements did not occur, the movements then being irregular. Therefore, McNally maintains that each of the four vertical canals is a sentinel at its own portion of the head. The vertical canals, acting together with the utricles in control of the musculature of the head, body and limbs, help to maintain the normal erect posture of the head during movement or at rest.

In a painstaking, detailed study of the function of the saccule, Ashcroft and Hallpike,[39] employing McNally's microdissection technic of the frog's labyrinth, approached their study along electrophysiologic lines by using action currents. They were unable to elicit from the exposed nerve any response to movements of tilting or of rotation. In response to vibration, however, a marked reaction was observed in most cases, since the saccule in the frog contains end-organs concerned with vibrational sensibility. They conclude that the action currents occur in response to vibrational stimuli, the frequency of the stimulus being reproduced accurately up to a frequency of at least 500 double vibrations. These the authors feel are true action potentials. They believe that their experimental results support the suggestion of Tait that in man the saccule is concerned in the reception of bone-conducted sound and that probably both telephones and resonance mechanisms are concerned in the psychologic process of pitch discrimination.

Tait[40] calls attention to the fact that the eighth cranial nerve subserves both an exteroceptive (auditory) and a proprioceptive (equilibratory) function. Its equilibrial receptors (the semicircular canals and the utricular macula) are placed anteriorly; the cochlea, or auditory apparatus, is placed posteriorly. The function of the saccular macula, which lies between the proprioceptive and the exteroceptive sense organs, is still unknown. Tait presents evidence in support of the view that it is auditory.

While the cochlea and its accessory apparatus (membrana tympani, ossicles, and so forth) all vibrate in an otherwise immobile head, the saccular macula presumably responds to actual vibration of the head. Tait feels that it is during voice production that the saccular macula is

39. Ashcroft, D. W., and Hallpike, C. S.: On the Function of the Saccule, J. Laryng. & Otol. **49**:450 (July) 1934.

40. Tait, J. F.: Is All Hearing Cochlear? Ann. Otol., Rhin. & Laryng. **41**:681 (Sept.) 1932.

stimulated since the construction of the saccular receptor suggests that vibration is necessary for its stimulation. It is thus a proprioceptive and not necessarily an exteroceptive auditory organ. It responds to the tremor of the head which invariably accompanies the spoken voice. Only when whispering is it possible to hear one's own voice by means of the cochlea alone, and because of the absence of saccular stimulation it is impossible to recognize the phonographic record of one's own voice.

Occasional cases arise in which the saccular apparatus is disabled without involvement of the cochlea. Only when a number of properly selected patients have been thoroughly examined and interrogated from this point of view and the findings have been subsequently checked by anatomic examination will it be possible to determine whether or not the hearing of one's own spoken voice involves the mediation of two separate labyrinthine receptors (cochlea and saccular macula).

NYSTAGMUS

Mackenzie [41] presents his experience with nystagmus based on twenty-seven years of practice. As concerns undulatory nystagmus, he says that it is not present in all cases of visual defects per se, but only in those in which the central vision is especially involved. Since the macula is poorer there than elsewhere, the eyes move past the fixation point, and when the patient discovers that he has missed it, he reverses the movement. These movements are rhythmic regardless of the fact that the patient may look to the right or to the left.

Mackenzie takes exception to the theory that vertical nystagmus is an indication of a lesion of the brain stem, as he has seen a number of cases in normal persons. Spontaneous nystagmus is of purely labyrinthine origin only as long as it is present when the patient looks straight ahead. Mackenzie expresses the intensity of nystagmus by adding the distance of all the quick movements which occur in a given length of time. Thus, if each nystagmic movement constitutes an excursion of 1 mm. and there are a total of twenty excursions in twenty seconds, the nystagmus is twice as intense as that of another patient who exhibits half the number of excursions of the same length in the same period of time. In other words, the number of excursions multiplied by the length of one excursion in millimeters divided by the time factor in seconds equals the intensity of the nystagmus.

He concludes his article by saying that the entire Politzer school, including Bárány, who studied nystagmus with the patient looking first toward one side and then toward the other, employed a technic that was faulty.

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41. Mackenzie, G. W.: Nystagmus, J. Am. Inst. Homeop. **27**:16 (Jan.) 1934.

German [42] repeats what Bruening, Kobrak and others have said regarding caloric stimulation of the labyrinth, a method which has been used exclusively on the continent. After carrying out caloric stimulation of the vestibular apparatus with a weak stimulus (10 cc. of water at 20 C.), German concludes that the test is simpler, more accurate and more sensitive than the method of profuse douching. He says:

> Probably the most important step has been the modification according to which the douching is performed in indifferent posture of the head and the test for the reaction is carried out in the optimum position of the head. The advantages of the procedure are as follows: it causes neither vertigo nor subjective complaints and, should there be a traumatism, may be applied by way of sensitization from the other side. Owing to the elimination of inhibitory factors the results afford a clearer picture of the irritability of the vestibular nerve than do the profuse douches, the latter disclosing rather the peripheral differences at the expense of the differences in the central tonus. The physiological portion of the latent period can be isolated, whch is of prominent importance for the appreciation of the vestibular irritability. Further, the procedure furnishes materially more exact results because it admits of a test without straining the extraocular muscles. . . .
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> Thus we can consider otoneurologic diagnostics improved first from the point of view of side location, in that not only in the primary position of the eyeballs do differences in tonus occur but also on the tests made in extreme side position; and second, from the point of view of central or peripheral vestibular hyperesthesia, in that in any position the nystagmus has rotatory character, when the head is abruptly titlted backward.

According to Caussé,[43] ocular movements in a normal human subject may be classed as voluntary (active optic fixation), passive optic (optokinetic reflex) and passive vestibular (labyrinthine reflexes). In previous investigations of this question only the longitudinal form of optic movement (elevation, depression and lateral movements) and convergence have been studied. Rotatory movements around the anteroposterior axis have received little attention, although their great importance from the vestibular standpoint is manifest. While the labyrinthine influences can produce rotatory nystagmus or ocular counterrolling, it is not possible voluntarily to rotate the eyes around the anteroposterior axis. With the technic of Borries it is possible to obtain passive optic rotatory movements, but they differ from other forms of optokinetic reactions in that they are inconstant, slow and of short duration; accommodation suppresses them, and the law of Bárány that optic nystagmus always overcomes vestibular nystagmus is in default. Caussé therefore believes that the conclusion is justified that longitudinal movements

42. German, T.: The Use of Caloric Nystagmus Elicited by Weak Stimuli and Its Partial Phenomena in Otoneurologic Diagnostics, Laryngoscope **42**:788 (Oct.) 1932.

43. Caussé, R.: Optokinetic Nystagmus with Rotatory Form, Rev. d'oto-neuro-opht. **10**:100 (Feb.) 1932.

are essentially under optic influence (active and passive), which largely overcomes the vestibular influence. Rotatory movements, movements which are strictly reflex, are almost exclusively dependent on the vestibular apparatus.

In the lower vertebrates ocular movements are controlled exclusively by the labyrinth. In the course of evolution and with the development of cerebral function, passive and then active ocular motility which is independent of the labyrinth becomes possible. In man this independence is complete; in fact, the eye supplements the vestibular function. Nevertheless, in the function of rotatory motility of the globe the ancestral servitude of the eye to the labyrinth is marked.

In a comprehensive experimental survey of ocular movements Spiegel [44] concludes:

> . . . the origin of the rhythm observed in nystagmus is to be sought in the central part of the reflex arc, which connects the labyrinth, the vestibular nuclei and the ocular muscle nuclei. It has been shown that the ocular muscle nuclei themselves and the substantia reticularis are not necessary for the genesis of this rhythm, and so one might conclude that the vestibular nuclei themselves are the place where this rhythm originates. To understand this mechanism, one might recall the explanation given for the slow deviation of the nystagmus. The slow deviation of both eyes, for instance to the left side, was explained thus: The L-cells of the vestibular nuclei are stimulated and the R-cells are reached only by lowered impulses, so that the vestibulo-mesencephalic tracts starting from these cells and innervating the muscles that move the eye toward the right side are inhibited. If abnormally strong impulses or those of long duration reach the L-cells, these finally become fatigued, and they will send no impulses toward the R-cells or toward the ocular muscles. The muscles that move the eyes to the left side will receive no more impulses, and, at the same time, the inhibition of the antagonists will cease. The muscles that move the eye to the left side will relax due to exhaustion of the L-cells, and reflex impulses or impulses from higher centers can now reach the R-cells without inhibition, with the result that there are fast movements of both eyes to the right during the short period of exhaustion of the L-cells. When the L-cells have recovered, they again send impulses to the left external rectus and the right internal rectus, at the same time inhibiting the antagonists, and the whole cycle starts again.
>
> The importance of impulses from the higher centers that reach the vestibular nuclei (especially cortical impulses) is shown by the fact that the voluntary movement of the eyes in the direction of the fast component of the nystagmus increases the nystagmus. Furthermore, after extirpation of the forebrain on one side, a nystagmus is more easily produced with the fast component to the side of the operation than with it in the opposite direction. This influence of the cortex on the labyrinthine nystagmus is explained by the fact that the corticofugal fibers for horizontal movements of the eyes reach the vestibular nuclei before they are transmitted to the ocular muscle nuclei, as has been shown for the impulses from the frontal lobe, and for the impulses from the occipital lobe.

44. Spiegel, E. A.: Physiopathology of the Voluntary and Reflex Innervation of Ocular Movements, Arch. Ophth. **8**:738 (Nov.) 1932.

Unterberger [45] states that the observation of nystagmus and its strength and direction may indicate a decompensation but that it gives no information as to the actual excitability of the labyrinth in question. This is true of the postrotatory (as now evaluated) as well as the caloric nystagmus. While the actual excitability of the labyrinth cannot be judged by the postrotatory nystagmus obtained in the direction of the labyrinth in question or by the relation of the postrotatory nystagmic reactions to each other, it can be determined by the total value of the postrotatory nystagmus, which is obtained by the addition of the two values. This is possible because the total values do not depend to the same degree as do the individual values on the appearance of decompensation or compensation.

On the basis of his determinations, Unterberger draws important diagnostic conclusions concerning the degree of vestibular excitability and the impairment of labyrinthine function. The results of rotatory tests were formerly often interpreted incorrectly; this can be avoided in the future by also taking into consideration the total value of the postrotatory nystagmus, which makes much more accurate diagnosis possible. The total value of the postrotatory nystagmus is especially important for the differentiation of various forms of labyrinthine inflammation with preservation of function, not so much as to their types as to the extent and the degree of the impairment of the labyrinthine functions. The author suggests the term "labyrinthism" to describe a condition characterized by the absence of a fistula, slight manifestations of decompensation and normal or practically normal total postrotatory nystagmic values.

Woletz [46] studied postrotatory nystagmus in fourteen normal persons according to the method of Fischer, using the electric rotary chair of Tönnies. With this new method three minutes are required to bring the speed of rotation to 180 degrees per second, the angular acceleration remaining below the threshold for vestibular stimuli. After this speed has been maintained for the desired period, the rotation is quickly arrested. With the clinical method, two opposite stimuli succeed each other within a short interval; with the new method, only one stimulus, the terminal retardation, is observed. After the arrest of rotation "first postrotatory nystagmus" develops with the rapid component in the direction opposite to that of the rotation. This has an average duration of twenty-eight seconds and an average of forty-eight movements, giving

45. Unterberger, S.: Quantitative Determinations of Labyrinthine Function with Total Postrotatory Nystagmus: Significance in Otitis Interna, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **136**:248 (Sept. 21) 1933; abstr., Arch. Otolaryng. **19**:517 (April) 1934.

46. Woletz, F.: Quantitative Studies of Postrotatory Nystagmus, Ztschr. f. Hals-, Nasen- u. Ohrenh. **33**:476 (Sept. 4) 1933; abstr., Arch. Otolaryng. **19**:394 (March) 1934.

a frequency of 1.6. The first nystagmus is followed by a pause of an average duration of fifteen seconds. The pause also varies with the direction of the rotation and at different test periods. A second postrotatory nystagmus occurred in all the subjects. The movements of this nystagmus are much smaller and are frequently grouped; its average duration is sixty seconds, with an average of thirty-seven beats. The individual variations are greater than in the first nystagmus, and the personal differences in reactions at different test periods are unusually large. The difference in reactions between rotation to the right and that to the left is also greater than in the first postrotatory nystagmus. This is probably due to asymmetry of the central nervous system. In 10 per cent of the tests the second rotatory nystagmus was followed by further nystagmic rhythms, with a change of direction in some cases. The regular phases which characterize postrotatory nystagmus must be due to rhythm in the central nervous system. The author considers this procedure the method of choice for testing postrotatory nystagmus.

Wittmaack [47] says that Huizinga's observation that typical nystagmus can still be evoked by galvanic stimulation after destruction of the cupula and the epithelial border, which indicates that galvanic stimulation acts directly on the peripheral terminations of the nerves, is in keeping with his own theory of tonus and is corroborated by some of his experiments. These facts indicate that the shifting of the fluid, which according to his theory takes place in the cupula during the act of stimulation and which causes the drop in pressure necessary to produce the stimulus, also occurs along minute liquor canals through the epithelial border into the subepithelial tissue. With this in mind he studied the region of the subepithelial tissue during a state of excitation. In the microscopic examination of corresponding regions of two cristae which were in opposite states of stimulation during decapitation of an animal, a marked difference in the condition of the subepithelial tissue was noticed. Analogous though slightly less pronounced differences in the subepithelial tissue were found in caloric and rotatory stimulation. In the crista stimulated with cold water the ascending nerve fibers in the subepithelial tissue appeared wider and paler than those in the crista stimulated with hot water, the former corresponding to a direct depressive action and the latter to a direct compressive action on the nerve endings, as indicated by Huizinga.

In experiments on animals Wittmaack [48] found that compression of the perilymphatic space through its direct influence on the endo-

47. Wittmaack, K.: Morphologic Picture of Crista Acustica During the State of Stimulation, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **135**:41 (May 17) 1933; abstr., Arch. Otolaryng. **19**:100 (Jan.) 1934.

48. Wittmaack, K.: Theory of Fistular Symptom of the Labyrinth, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **132**:115 (Aug. 23) 1932; abstr., Arch. Otolaryng. **17**:265 (Feb.) 1933.

lymphatic space regularly produced nystagmus to the side involved in the experiment whereas direct pressure (contact) on the exterior wall of the utriculus above the fenestra ovalis regularly produced a nystagmus in the opposite direction. The author thinks that the regular fistular symptom characterized by nystagmus to the diseased side takes place in the same way as nystagmus through experimental compression of the perilymphatic space. Production of the reversed fistular symptom in his opinion takes place in the same way as the reversed nystagmus produced experimentally by direct pressure on the wall of the utriculus. Compression of the perilymphatic space produces a simultaneous "circular" compression of the endolymphatic space of the utriculus, because the cochlear duct does not permit a sufficient escape of endolymph to compensate for the effect of the pressure. That a circular compression of the endolymphatic space of the utriculus provokes nystagmus to the side being tested conforms to the author's tonus theory that the specific excitation of the sensory organ of the inner ear consists in a hydrostatically transmitted increase of pressure in the sensory structures in the endolymph. When pressure is applied directly to any point on the exterior wall of the utriculus, the endolymph may escape through the endolymphatic duct into the endolymphatic sac because the duct is not pressed shut as in compression of the perilymph. This displacement of the endolymph, besides decreasing the effect of the pressure, produces a reaction in the sensory organs which results in nystagmus to the opposite side. If the fistula is in the horizontal semicircular canal the displacement must affect the crista of the vertical semicircular canal as well as that of the horizontal one, resulting in a horizontal-rotatory nystagmus. In accordance with this theory, the author thinks that the form of the nystagmus may, under certain circumstances, permit conclusions as to the anatomic conditions which exist.

Collet and Mayoux [49] report two cases that have come under their observation and from which they venture an explanation of the mechanism of the fistular sign. They state that two hypotheses explain this sign. The first is that movement of the endolymph causes the nystagmus, and the second is that the fistular sign is an otolithic reaction. Herzog expressed the belief that to produce the fistular sign two weak points in the labyrinthine capsule are necessary: the fistula and the fenestra rotunda. Most often the compression acts through the fistula, and nystagmus toward the diseased side is produced; if the force acts through the fenestra rotunda, the nystagmus is toward the healthy side. The observations of Collet and Mayoux support the conclusion that the change in the direction and intensity of the nystagmus produced by

49. Collet, F. J., and Mayoux, R.: The Mechanism of the Fistular Sign, Rev. d'oto-neuro-opht. **11**:427 (June) 1933; abstr., Arch. Otolaryng. **19**:738 (June) 1934.

compression and aspiration may be explained by the presence of a current of endolymph toward or away from the ampullae.

VASOMOTOR PHENOMENA

Cantele,[50] in an extensive article, discusses the labyrinthine system and the vasomotor and respiratory reflexes. He first reviews at length the researches made by numerous workers, especially those of Spiegel, Démétriades and Camis; then he gives the purpose of his own investigation, the technic, detailed descriptions of his most characteristic experiments and graphs of the tracings, indicating methods and periods of stimulations, alterations in blood pressure and respiration and also the appearance and duration of nystagmus. Later he summarizes his experiments and compares the final results with those of Spiegel, Démétriades, Versteegh, Arndts, McNally, Foà, Lunedei, Allers, Leidler and Camis. His conclusions are as follows:

1. The caloric and mechanical irritation of the vestibular apparatus is followed by a reflex action characterized by negative blood pressure noted in the carotid and femoral arteries. Slight inconstant and irregular variations in the respiratory movements are observed, which usually increase in rhythm with reduction in the amplitude of the excursions, especially during inspiration.

2. The fibers of the tympanic plexus, passing over the promontory near the stapes and posteriorly to the oval window, may participate in provoking the reaction of lowering the blood pressure. The route of transmission of this stimulus is supposed to be through the anastomotic fibers of the nervus intermedius.

3. The outflow of the perilymph from the vestibular cavity does not seem to have any influence on the level of the blood pressure or on respiration.

4. Mechanical destruction of the peripheral labyrinth is immediately followed by few and irregular oscillations in the respiratory curve, which slowly and persistently tend to diminish.

Proby [51] describes a "vasomotor syndrome of the labyrinth" and includes many of the vestibular disturbances that are not associated with definite pathologic changes. Whatever their cause, all may be traced to a circulatory disturbance. The reflex may be direct (foreign body or cicatrix) or may arise from a chronic infection, a suppurating focus or hepatic insufficiency. Often no cause is found. Bone conduction and the reaction to cold irrigations of the ear are much reduced. Other

50. Cantele, P. G.: Experimental Research on the Labyrinthine System and the Vasomotor and Respiratory Reflexes, Arch. ital. di otol. **44**:129 (March) 1933.

51. Proby, H.: Vasomotor Syndrome of the Labyrinth, Rev. d'oto-neuro-opht. **11**:182 (March) 1933; abstr., Arch. Neurol. & Psychiat. **32**:1079 (Nov.) 1934.

examinations give negative results. It is the evolution of the disease that differentiates the cases of circulatory disturbance from those of chronic infection of the labyrinth. The lesions disappear in the former and persist in the latter.

Muck has reported that in many persons mechanical, thermal or electric stimulation of the vertebral or the radial arteries (the periarterial plexus of which is innervated by the inferior cervical ganglion of the sympathetic nerve) produces a rhythmic horizontal nystagmus. If the result is positive, the white streak sign is seen in the epinephrine probe test. This shows that the experimentally produced nystagmus is of vasomotor origin, a fact which is of practical as well as of physiologic significance. With the aid of the aforementioned stimuli, spontaneous nystagmus not of labyrinthine origin can be made to disappear. The author reports [52] several cases in which a spontaneous nystagmus was made to disappear, and he concludes that the nystagmus in all cases was of vasomotor origin. That the nystagmus could not be of labyrinthine origin was shown by the fact that in several cases of nystagmus of certain labyrinthine origin the aforementioned stimuli had no influence on the nystagmus. Probably the nystagmus that disappears on stimulation of the radial or the vertebral arteries is due to a disturbance in the blood supply in the region of Deiters' nucleus.

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52. Muck, O.: Nystagmus of Vasomotor Origin and Its Differentiation from Labyrinthine Nystagmus, Ztschr. f. Hals-, Nasen- u. Ohrenh. **30**:668 (July 22) 1932; abstr., Arch. Otolaryng. **17**:587 (April) 1933.

Correspondence

THE RIGHT ANGLE INCISION IN THE RADICAL (CALDWELL-LUC) ANTRUM OPERATION

To the Editor:—In the February issue of the ARCHIVES OF OTOLARYNGOLOGY (**21**:206, 1935) there is a short article by Dr. L. P. Monson in which a new incision for the Caldwell-Luc operation is described. Dr. Monson compares this incision with the vertical one and rates them both as superior to the classic horizontal incision.

He repeats the statement, made by Carmody and many others, that because these incisions are in line with the infra-orbital nerves they are followed by less dental anesthesia and less paresthesia of the cheek.

Granted that this is true, it is not due entirely to the incision. With the horizontal incision the only fibers cut are those going to the gum, below the incision. None of the fibers going to the teeth or to the lip are cut, because the infra-orbital nerve does not supply the teeth, and its branches to the lip are superficial to the periosteum. They may be stretched or crushed but not cut.

The upper teeth are supplied by the superior alveolar nerves, through the superior dental plexus. None of these branches can be cut by any mucoperiosteal incision, as they run in the bone. They are injured only when the bone is opened or the antrum is curetted hard enough to open their canals. This can be verified by reference to any standard anatomy.

Most of the unpleasant sequelae to this operation are not due to the incision but are inherent to the operation itself. With the horizontal incision, it is easier to expose the bone, and the bone defect is made larger; with the others, it is harder to expose the bone, and the defect is made smaller with less damage to the nerves.

The Caldwell-Luc operation is a valuable procedure, when indicated. It has some unavoidable sequelae. If these are less after one incision, that is the procedure to use. But when men say that the teeth are supplied by the infra-orbital nerve, one is entitled to wonder whether their conclusions are any better than their knowledge of anatomy.

H. P. MERRILL, M.D., Los Angeles.

Abstracts from Current Literature

Ear

FUNCTION OF THE SACCULE. D. W. ASHCROFT AND C. S. HALLPIKE, J. Laryng. & Otol. **49**:450 (July) 1934.

Ashcroft and Hallpike recorded the action currents in the saccular nerve of the frog, employing a micromanipulative technic in combination with a conventional amplifying system and a cathode ray oscillograph. The action currents occur in response to a vibrational stimulus, the frequency of the stimulus being reproduced accurately up to a frequency of at least 500. Reasons are given for regarding the electrical changes recorded as true action potentials. It is concluded that the saccule in the frog is an organ of vibration sense. It is thought that the experimental results support the suggestion of Tait that in man the saccule is concerned in the reception of bone-conducted sound. The implications of this possibility as they affect the problem of bone conduction and that of the mechanism of pitch perception in general are discussed. It is thought likely that both telephone and resonance mechanisms are concerned in the psychologic process of pitch discrimination.

EDITOR'S ABSTRACT.

CHOLESTEATOMA OF THE SKULL. W. LOEPP, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:65 (May 17) 1934.

Loepp discusses cholesteatoma of the pyramid and of the remaining cranial region. He states that in the last two and one-half years he has observed seventy-seven patients with cholesteatoma of the pyramid, and fifty-six of these were operated on and chosen for study. Some showed differences between the roentgenologic and operative findings, and these differences the author analyzes and attempts to explain. In doubtful cases of cholesteatoma the form of the defect in the roentgenogram is important. A sharply and regularly circumscribed bone defect with a corresponding light area in the region of the lateral attic wall or of the mastoid portion extending to this from the region of the antrum speaks for cholesteatoma. A smaller streak shadow which borders this light area in the mastoid and the absence of the posterior part of the upper wall of the auditory meatus, so that the attic and the antrum form a cavity, are also characteristic. In concluding one may say that the diagnosis of the classic cholesteatoma depends on the visual interpretation of the roentgenogram. Many cholesteatomas may be diagnosed only by this means. These purely congenital cholesteatomas of the pyramid lead to those of the rest of the cranium. As to the origin of the latter, also, there is no definite understanding as yet. The only certain fact is that they are not of inflammatory origin. In one case, for example, the roentgenogram showed a long, sharply circumscribed defect of the left side of the skull in the region of the frontoparietal suture. The flat and slightly thickened bony contours made the author consider cholesteatoma, especially in view of the long duration of twelve years. The condition, however, was glioma. The diagnosis of cholesteatoma in other regions of the cranium on the basis of roentgen observations is therefore uncertain.

EDITOR'S ABSTRACT.

THE NATURE OF THE SYNDROME OF HERPES ZOSTER OTICUS. A MINKOVSKY, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:131 (May 17) 1934.

Minkovsky discusses the anatomy of the ear and the relation and anastomoses of the neighboring nerves in connection with herpes zoster oticus. Therapy is symptomatic, and the prognosis is good from the standpoint of life, but from that of functional results doubtful.

EDITOR'S ABSTRACT.

ORIGIN AND OPERATIVE TREATMENT OF OTOGENOUS BRAIN ABSCESS OF LEFT OCCIPITAL LOBE. H. RICHTER, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**: 158 (Aug. 22) 1934.

Richter reports the case of a girl, aged 17, with an abscess in the left occipital lobe. The abscess apparently developed in the course of a sinus thrombosis following acute otitis media by way of a thrombophlebitis involving the cerebral vein. Aphasic disturbances were not observed during the course of the disease. The abscess was opened and drained. The patient showed rapid recovery.

EDITOR'S ABSTRACT.

THE ENDOSTEAL LAYER OF BONE OF THE HUMAN LABYRINTHINE CAPSULE. K. GASTAUER, Arch. f. Ohren.-, Nasen- u. Kehlkopfh. **138**:204 (Aug. 22) 1934.

Gastauer states that a certain general but not absolute regularity in the arrangement of the endosteal layer of bone is present mainly in the cochlea and the vestibulum. The site of the endosteal bone is always in the semicircular canals, and such bone develops without exception only in those sections in which the endochondral bone layer from the beginning has not developed, namely, in both vertical semicircular canals on the sides near the internal pyramidal surface. If regularity cannot be considered because of the many exceptions, then regularity of the wall of the semicircular canal in all other sections is not to be thought of. The growth processes of the semicircular canals cannot be determined by the anatomic conditions of the endosteal bone position, because the signs of resorption are rarely found on the sides adjacent to the center of curvature. According to Bast's investigations, the intravital growth in itself is not possible. The causes of the presence or absence of endosteal bone positions could not be determined. The anlagen as well as the local intravital resorptive processes may play a rôle in the distribution of this layer of the labyrinthine capsule.

EDITOR'S ABSTRACT.

TECHNIC OF PLASTIC CLOSURE OF A RETRO-AURICULAR DEFECT. H. FREY, Monatschr. f. Ohrenh. **68**:804 (July) 1934.

Frey describes a new technic for closure of a retro-auricular defect. The usual linear closure leaves a weak spot and consequently facilitates a later reinfection of the middle ear. He therefore changed the side to side anastomosis into a surface connection by means of a technic which he describes as characterized by a double suture. The exact method is designated in detail with illustrations.

EDITOR'S ABSTRACT.

IS THERE A NOISE DEAFNESS OF MINERS? O. MUCK, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.) **25**:159, 1934.

Muck reports the results of his investigations on the hearing of miners who work constantly with compressed air tools. The question of possible defects of hearing is important because of the occupational element. Of the 402 patients tested, 300 had worked, on the average, five years with compressed air instruments, and 100 for ten years. In 387 of the 402 miners the whispered and conversational voice was normal. Some degree of deafness was found in 15. In 9 of these, it was explained on the basis of cerumen, otosclerosis or otitis media, or as residual from a purulent process. The author therefore concludes than an injury to the organs of hearing due to long-continued work with compressed air instruments in the sense of an occupational injury is not the rule EDITOR'S ABSTRACT.

THE SPHERICAL TUBE OF KIRCHER AND THE RESONATOR OF VON HELMHOLTZ. G. PANCONCELLI-CALZIA, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.) **25**:162, 1934.

Panconcelli-Calzia discusses the origin and historical development of Kircher's spherical tube and von Helmholtz' resonator. EDITOR'S ABSTRACT.

Pharynx

FAMILIAL LYMPHOCYTOSIS. H. RICHTER, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:172 (Aug. 22) 1934.

Richter presents two patients, aged 13 and 21, respectively, showing a constant lymphocytosis with a normal or slightly subnormal total number of leukocytes. The first indication for an examination of the blood in each case was an acute inflammatory pharyngitis accompanied by swelling of many lymph nodes. The first case was one of acute pharyngitis; the second, one of gangrenous angina. In both cases the lymphocytosis was still demonstrable after complete recovery. In close relatives of the patients the general state of the blood was characterized by lymphocytosis. Richter concludes that the tendency to lymphocytosis is familial and hence constitutional. He attributes a secondary rôle to the infection.

EDITOR'S ABSTRACT.

INFLUENCE OF TONSILLAR ENUCLEATION ON SUBSEQUENT SCARLET FEVER AND DIPHTHERIA. A. VON ZSINDELY, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**: 195 (Aug. 22) 1934.

Von Zsindely made a comparative study of several thousand cases of scarlet fever and diphtheria which occurred before and after tonsillectomy. He found that in most cases tonsillectomy decreases the incidence of infection from both diseases. This decreased incidence after tonsillectomy seems, however, to decline parallel with the time which has elapsed after operation.

EDITOR'S ABSTRACT.

Larynx

THE PATHOGENESIS OF FUNCTIONAL WEAKNESS OF THE VOICE (PHONASTHENIA). N. R. BLEGVAD, Monatschr. f. Ohrenh. **68**:833 (July) 1934.

Blegvad defines phonasthenia as a chronic fatigue of the organ of speech which occurs in speakers and singers as a result of poor technic or because of local or general disease. It develops as an abnormally early or intense fatigue of the musculature of the organ of speech and the corresponding ganglion cells. In neuropathic persons this chronic fatigue is accompanied by a decided disturbance of intonation, which is probably due to weak muscular contraction in response to the nerve impulse. Another early symptom is laryngeal tremolo, resulting from fatigue of the nerve cells. Fatigue can often be accompanied by pains, which may be localized to the larynx but are usually felt in the region of the throat or tongue and radiate from there to the neck, jaw, chin, maxilla or sternum. This is no sign that the pains are neurasthenic or are simply radiated, but rather that in intense degrees of fatigue more muscles are involved than are normally employed in speech formation. In long-standing phonasthenia, especially when the voice is continually used, severe, irreparable changes ensue. Atrophy of the laryngeal muscles and paresis of the vocal cords occur. The glands suffer, so that the mucosa becomes dry, the capillaries relax, and the mucosa becomes reddened and swollen. It is thus not surprising that phonasthenia in advanced cases is incurable just as is bodily overfatigue.

EDITOR'S ABSTRACT.

Nose

RELATIONS BETWEEN OZENA AND THE CERVICAL SYMPATHETIC BASED ON HISTOLOGIC OBSERVATIONS OF NERVES. P. KRAMPITZ, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:107 (May 17) 1934.

It has appeared to Kampitz that ozena often involves not only changes of the mucosa and skeleton of the nose but also of the outer skin. Among the theories of the origin of ozena is the one that the condition is trophoneurotic. Weighing the favorable effect of sympathectomy on trophoneurotic conditions elsewhere, e. g.,

angiospasm, the author was led to weigh the possibilities of similar procedures applied to the nasal region. Certainly relationships between the sympathetic system and ozena have been frequently observed. In one patient with intractable ozena he removed the superior cervical ganglions of both sides at separate operations. The clinical course after the second operation was noteworthy. There was practically no pain on swallowing or any noticeable edema in the throat or larynx. After about three days the nose was moist again. The crusts were relatively scarce and were easily expelled by blowing the nose. The changes in facial appearance were less marked, and both eyes showed practically the same behavior. About ten months after the bilateral operation the patient remained improved. Histologic examination of the superior cervical ganglions showed a round cell infiltration. Krampitz therefore believes that there is a close association of ozena with the sympathetic system. The relationship between ozena and so-called otosclerosis makes the latter worthy of investigation from the standpoint of disturbance of the vegetative system. EDITOR'S ABSTRACT.

Miscellaneous

ZOSTER OF SOME CRANIAL NERVES (ZOSTER CEPHALICUS) WITH FOUR PERSONAL CASES. L. S. SVENSON, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:89 (May 17) 1934.

Svenson discusses four personally observed cases of herpes zoster of the cranial nerves and the possible relation of this disease to other virus diseases, especially encephalitis. In the first case, the exudate in the tonsil region brought diphtheria under consideration. When no diphtheria bacilli were found, a basal meningitis from a septic angina was believed to be the cause. The further course of the disease and the discovery of herpetic vesicles on the buccal mucosa established that a zoster infection was the origin of the meningitis and of the involvement of the different ganglions. In the second case, also, a clear zoster infection was involved, the exact origin of which was, however, not plain. The infection probably followed the trigeminal fibers to the gasserian ganglion and then along the meninges to the vestibular ganglion. In the third case there was a zoster infection of the fifth, seventh and eighth cranial nerves. Probably the mucosa of the throat and mouth was the portal of entry of the virus. The last case was not certainly one of zoster infection. This patient, in contrast to the other three, did not have a vaccination against smallpox before the onset of the illness. The course of the condition indicated, nevertheless, a zoster cephalicus. The differential diagnosis of zoster infection of the cranial nerves and encephalitis is often difficult. This is not surprising in view of the close relationship of the viruses of the two conditions. The author believes that pains in the region of the right ear at the onset of the illness speak for a zoster cephalicus in which the trigeminal and facial ganglions are involved first. EDITOR'S ABSTRACT.

THE NATURE OF "GLOSSITIS RHOMBICA MEDIANA." H. O. LOOS and L. HÖRBST, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:122 (May 17) 1934.

Loos and Hörbst studied the condition of the tongue characterized by a rhombus-shaped, reddened, sharply demarcated lesion lying medially in the middle third of the tongue and named by Lane "glossitis rhombica mediana." The origin and nature have been heretofore uncertain. They examined histologic sections (removed under local anesthesia) in eight cases. Microscopic observation showed a definite similarity of all of these. A marked widening and thickening of the involved epithelium was found. In the upper layers were numerous nucleated horn cells with keratohyaline granules. Often the hornifications were in a sphere-shaped form. In all cases there was an absence of taste papillae. The epithelium also showed a small amount of leukocytic and lymphocytic infiltration. One case differed from the others in that mitotic figures were shown in the epithelium. The submucosa was rich in widened blood and lymph vessels

of different sizes. The larger blood vessels were thin-walled and delicate. The lumens were sometimes empty and sometimes filled with erythrocytes. In one case the deeper vessels showed sinus-like widening. In the neighborhood of the capillaries were small agglomerations of round cells and plasma cells, which were also present in small numbers in the connective tissue. Also near the larger vessels were collections of round cells and leukocytes, which decreased in number in the deeper layers of the lower mucosa. The most important observations in all cases were the absence of taste papillae, the epithelial hypertrophy, and the increased and widened blood and lymph vessels in the submucosa. These observations place the so-called "glossitis rhombica mediana" in the group of vascular nevi. The localization of the embryonal anlage of the tuberculum impar allows it to be placed in the group of fissured angioma. Evidences of chronic inflammation such as the changes in the epithelium are explained as secondary and due to chronic irritation of the faulty and functionally inferior tissue.

EDITOR'S ABSTRACT.

OSTEOMA OF THE JAW. T. VON BAJKAY, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:153 (Aug. 22) 1934.

Von Bajkay states that the osteoma develops from osteoblastic cells. The course of development is slow, painless and invasive. The growth may occur at any age and is more frequently found in men. An osteoma of the jaw is located on the surface, in the antrum of Highmore or in the superior maxilla. Microscopically the osteoma is ivory-like, compact, spongy or mixed. The tumor varies in size, but is generally the size of a pea. Symptoms vary according to the site and spread of the tumor; they are generally vertigo, dull headache, tenderness, loss of appetite, vomiting and fever brought on by the pressure of the tumor or by the stagnation of the secretions. Secondary infection of the mucosa lining the antrum of Highmore or of the soft parts rarely occurs. Diagnosis is easiest when the bone-hard tumor can be palpated under the skin. Puncture cannot be done because of the bone hardness of the tumor. Differential diagnosis is often aided by roentgenography; the osteoma gives a characteristically delineated border and a markedly dark shadow. Osteoma may be differentiated from osteofibroma only by operative findings and histologic examination. The prognosis is generally favorable. Treatment consists in complete operative extirpation of the tumor. The patient must be observed for a long period of time after operation to determine any possible recurrence.

EDITOR'S ABSTRACT.

ASPIRATION METASTASES IN THE BRONCHI AND LUNGS IN A CASE OF LARYNGEAL CANCER. E. VON ZALKA, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:164 (Aug. 22) 1934.

On the basis of his own case and a review of the literature, von Zalka considers it as established that metastases may appear in the bronchi and in the lungs as a result of aspiration and implantation. He states that in the majority of cases the cells and particles which detach themselves from the surface of the tumors die or show histologic signs of severe degeneration. From careful examination of the sputum in cases of pulmonary cancer he found that in rare cases there was no histologic indication of degenerative changes; thus it could not be proved on a histologic basis that such cells are incapable of continued life. The ramification of the bronchi and of the alveolar structures of the lungs make it possible that the tumor cells or particles, as a sequel to aspiration, cling to the site, evince growth and form metastases.

EDITOR'S ABSTRACT.

INJECTION OF ALCOHOL INTO THE GASSERIAN GANGLION. K. FALKENBERG, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:184 (Aug. 22) 1934.

Falkenberg treated eleven patients who had severe trigeminal neuralgia by injecting 2 cc. of 85 per cent alcohol into the gasserian ganglion. A complete

cure was established in five patients, while in two patients certain symptoms returned after a short while which did not warrant further treatment. One patient could not be observed long because he died of a tumor of the brain. Two showed slight improvement and continued with the treatment. Only one did not evince favorable results after the injection. The author did not observe any signs of intolerance; neither neuroparalytic keratitis nor motor disturbances were present. Subsequent examination revealed in most cases that in spite of the hypesthesia resulting from the injection of alcohol the sensitivity was completely restored without the rise of new attacks of pain. This proves that despite the return of sensitivity the trigeminal neuralgia need not recur.

EDITOR'S ABSTRACT.

SYMPTOMATOLOGY OF STUTTERING. E. FRÖSCHELS, Monatschr. f. Ohrenh. **68**:814 (July) 1934.

Fröschels discusses the historical aspects and the recent studies and theories of the symptomatology of stuttering. He feels that investigations along the lines of psychoanalysis and individual psychology offer almost unlimited opportunity for a further clarification of the symptomatology of stuttering.

EDITOR'S ABSTRACT.

ENDOSCOPIC EXAMINATION OF THE LENGTH OF THE CRICOID CARTILAGE OF THE ESOPHAGUS. F. HASLINGER, Monatschr. f. Ohrenh. **68**:853 (July) 1934.

Haslinger emphasizes the difficulty of detecting a foreign body lodged in, or directly under, the cricoid cartilage of the esophagus. Such a foreign body is frequently overlooked when the endoscopic tube glides over a flat body located in the front or the back wall and also when it is not properly introduced in the middle line. The author presents a detailed description of endoscopic measures to be taken in such cases. He especially recommends a systematic examination of the length of the cricoid cartilage for a small, laterally lodged foreign body, together with a rapid twisting of the tube about its longitudinal axis.

EDITOR'S ABSTRACT.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Regular Monthly Meeting, Jan. 7, 1935

FRANK J. NOVAK, M.D., *President, in the Chair*

SOME PROBLEMS IN PLASTIC SURGICAL OPERATIONS ABOUT THE HEAD AND NECK, WITH BRIEF PRESENTATION OF CASES. DR. JOSEPH C. BECK.

In 1908 I presented before the American Triological Society a series of cases in which plastic surgical operations had been done. Most of the operations were major reconstructions, although there were a few performed for cosmetic purposes. In my paper I asked for a frank discussion as to whether this type of surgical operation is proper for our specialty because I had heard that some men considered it questionable or on the borderline of unethical. At that time I expressed opinions similar to Sir Harold Gillis' recent utterances.

Since 1908, I have in many instances refused to do cosmetic operations, thus falling into that group of surgeons which Gillis criticizes. However, I have done a fair number of reductions and building up of parts about the head and neck that are decidedly cosmetic. Today I am convinced that cosmetic surgery has come to stay and that surgeons not only should be willing to do the work, but should encourage it in all ethical ways. There are so many unscrupulous men in this field that the earlier surgeons let the public know that they are doing this work, the earlier will the poorly prepared advertising quack be driven out.

One important point is to make it possible for the person of average means to have this work done. Thus far, like prosthetic dentistry, plastic operations can be afforded by only the well-to-do. I believe that this is wrong and can be corrected. One should make a sharp distinction between cases in which to operate and those in which not to operate, because it has been my experience, as well as that of others, that no matter how good the results obtained most psychoneurotic persons will not be satisfied.

While I hope that this work may become a regular otorhinolaryngologic procedure and more widely spread, I believe plastic operations should be performed only by those who have prepared themselves in this field. Therefore, I urge the establishment of clinics devoted especially to plastic surgery, but only in the regular teaching institutions. I am confident that any one interested in plastic surgery can obtain advice, instruction or even courses in plastic reconstruction or cosmetic surgery from almost any of the many competent plastic surgeons.

It is well for the officers of local medical societies to be on the lookout for some of the quacks who are attempting to obtain memberships in the various societies for advertising reasons.

(Wax models were presented and a motion picture was shown which demonstrated the following conditions: frontal sinus deformity; defective soft palate; harelip and cleft palate, 2 cases; retro-auricular fistula; depressed nose; nasal defect in psychoneurotic patients, 2 cases; laryngostomy, 2 cases; esophageal fistula post laryngectomy; pharyngostomy; chin lifting; extensive skull defect; facial paralysis and ankylosis of lower jaw; periorbital osteomyelitis.) The histories of these cases were given, and attention was called especially to the fact that the problems refer particularly to the underlying pathologic conditions, such as osteomyelitis and neoplasms, which called for plastic reconstruction. The paper also had historical addenda from before, during and after the World War which were applicable to the points made.

DISCUSSION

DR. JOSEPH E. SCHAEFER: I think Dr. Beck has made a timely plea for the recognition and encouragement of cosmetic surgical practice as a legitimate endeavor of the otorhinologist. The practice of medicine represents a body of thought and action which has come down through the ages. It has remained intact while systems of government have flourished and disappeared; it has lived through all types of social and economic changes because it has had for its fundamental purpose the rendering of a service to humanity. Its basic purpose has been the maintenance of the physical and mental well-being of mankind. All things related to the practice of medicine must be tested for their validity by whether they do or do not conform to its fundamental purpose.

Questions never have been raised as to the legitimacy of efforts directed to the maintenance of the health of man's physical apparatus, but the importance of the fact that mental distress due to the maladjustment of the patient's emotional reaction may lead to more unhappiness and despair than physical illness has been greatly underestimated by the average practitioner of medicine. It remained for Freud through psychoanalysis to probe the unconscious mind and demonstrate how real emotional maladjustments may be, and how, if not corrected they may lead to all types of neuroses.

It is because certain physical defects about the face may cause so much mental anguish that I wish to enter a strong plea for the legitimacy of the type of service that has for its purpose the correction of these defects.

I think that the dental profession has been far in advance of the medical profession in the appreciation of the proper rôle that cosmetics play in human happiness and well-being. This is particularly true of that division of dental practice known as "prosthetic dentistry." The restoration of the anterior teeth by porcelain jacket crowns has cosmetics as its prime consideration. The construction of artificial dentures restoring facial contour and the proper relationship of the jaws are primarily cosmetic achievements, for the masticatory efficiency of these appliances is low when compared with that of the natural ones. The dental profession has carried tooth reproduction to such a point of excellence that it is often difficult to detect the presence of an artificial tooth among the natural ones.

The correction of an incomplete harelip, the removal of a disfiguring scar are done primarily for cosmetic reasons. Now wherein lies the difference of principle between this type of correction and the correction of a disproportionate and ugly-shaped nose or wide-outstanding ears, which may be just as distressing as the harelip or the disfiguring scar?

I had a lawyer recently tell me that he could not argue a case before the jury because he was so nose conscious that he believed the jury was constantly looking at his nose rather than directing their attention to what he was saying. Another young man, a salesman, rose to the presidency of his company in a few years after a correction of his nose had been made, which up to the time of the correction had made him shy and backward. One could relate case after case of this type concerning persons who are not psychoneurotic but sensitive and who have normal emotional reactions but who nevertheless suffer great mental distress because of certain facial imbalances.

The public has learned through newspapers, magazines and radio advertisements, as well as through the cinema, that certain types of facial corrections can be made by surgical procedures. The public cannot always discriminate between the legitimate practitioner of medicine and the quack, so I agree with Dr. Beck that it becomes the bounden duty of surgeons to see to it that this type of service is rendered honestly to the public. On no subject relating to the practice of medicine is the public more gullible, particularly the feminine half, than that which promises beauty with the removal of all types of physicial blemishes. One finds that the public is led into the offices of quacks by misleading articles in newspapers and magazines, only to be exploited and often mutilated because surgeons have neglected to live up to their full responsibilities.

Just last week I saw a victim of this dishonest type of practice. She had been led into the office of a so-called "plastic surgeon" through newspaper publicity. Although she was a young woman, the doctor proceeded to do a so-called "face lift," leaving behind bad scars, poorly placed; her nose was collapsed and disfigured by excessive removal of cartilage, and her ears flapped as if they were on hinges because of a crude surgical attempt at placing them closer to her head.

I have seen numerous cases of atresia of the nostrils following an attempt at nose reduction in which the patient had gone to the doctor because of nasal obstruction and had the nose tampered with without fully realizing what was going on.

It is this type of practice that brings discredit to the entire field of plastic surgery. It is because of these facts that Dr. Beck has pleaded for a more rational approach to and solution of the problems of cosmetic surgery.

This preliminary argument was followed by a review of a series of cases before and after plastic surgical intervention. The demonstrations were made by lantern slides.

The first cases shown were four of nasal deformities and their corrections.

The first nasal deformity consisted of a hump with an elongated tip. This was corrected through incisions made within the nostrils, freeing the skin entirely from the bridge of the nose and the alar cartilages. The hump was excised, the columella incised from the septum, the septum shortened, and the columella sutured back to the septum, with a secondary correction of the alar cartilages.

The second nasal deformity was a saddle nose which was corrected by a rib cartilage implant.

The third nasal deformity was a tip distortion. The deformity was due to excessive bulging of the alar cartilages with a depression in the midline between the alar and lateral cartilages. The alar cartilages were dissected free from the overlying skin through incisions made within the nostrils. The excessive alar cartilage was excised and transplanted, filling out the midline depression.

The fourth nasal deformity shown was an exceedingly large nose in a young woman. This called for a complete reconstruction. The skin was again freed from the bridge of the nose and from the alar cartilages through incisions made within the nostrils. About a quarter of an inch (0.6 cm.) was sawed off from the bridge, including the lateral cartilages and portions of the nasal bones. The septum was exposed from above and reduced about a quarter of an inch. The nose was shortened by separating the columella from the septum, the septum shortened and the columella sutured back to the septum with secondary corrections of the alar cartilages.

Two "face lifts" were shown; the first was performed on a person with Recklinghausen's disease, which had caused a great redundancy of the skin on one half of the face. The redundant skin hung down, completely obscuring the right eye. An incision was made along the hair-line; the excess of skin was excised and the skin drawn taut to the forehead, where it was sutured.

The second "face lift" was done for purely cosmetic purposes.

Two cases of reconstruction were shown.

The first case concerned a controlled carcinoma of the antrum which had left a perforation in the face about the size of a dollar. This was closed by a pedicle flap from the arm.

The second case of reconstruction concerned a controlled carcinoma of the mouth that had left a defect in the cheek such that a third of the lower lip was missing. This was also corrected by a pedicle flap from the arm.

The next two cases called attention to the importance, in cases of facial injuries, of the correction of depressed fractures at the time that the soft tissue injuries are repaired in order to avoid hopeless deformities of facial contour.

Dr. S. G. Higgins, Milwaukee: It may be interesting to this society to know the action taken by the staff of the Milwaukee County Hospital at the recent

annual meeting. The subdivision of plastic surgery was deleted from the surgical section. This permits oral surgeons who are interested in plastic surgery to do the plastic surgical operations in their field; also surgeons in other fields, such as ophthalmology and rhinology, who are prepared to have assigned to them the plastic surgery of their specialties.

Dr. Joseph C. Beck: These wax models were made by two or three different men, and several others have made them since I have been utilizing them. Dr. Lampert, who is a dentist, has been of great help. I wish to call your attention to the wax that is put on, which can always be made beautiful on the model, but the actual work does not always come out this way, and the patients are disappointed. The true models are valuable in medicolegal work, for they are accurate records of conditions.

Dr. Schaefer made a fine statement in regard to correcting deformities and malformations in reference to economic conditions. If you could see some of the persons whom I have seen with cellulitis and other conditions as a result of their having been operated on by quacks you would appreciate this better.

I wish to thank Dr. Schaefer for helping out in the matter of showing some of the cases technically. I tried to show some of the problematic things one has to deal with. It is the failures that really bother, and no matter how competent one is, failures are sure to occur, for instance in the nose and where ivory is not tolerated. Ivory is a foreign substance. I never liked it, but there are certain operations with which patients will take a chance.

Dr. Higgins' remarks prompt me to state that I have just returned from New York City, where I addressed the Society of Plastic Surgeons. If a person has the ability and the proper training there is no reason why he should not do plastic work. It is not always possible to refer a patient to some one else, and any one who is capable should do his own work of this character.

Cysts and Fistulas of the Neck. Dr. Roland Russell.

Six cases were reported. The terms "branchial" and "thyroglossal" as applied to cysts and fistulas, to which some writers object, seem more desirable than the terms "lateral" and "median" or "midline," which are proposed as substitutes, for the reason that not all thyroglossal cysts, either above or below the hyoid bone, are in the midline.

It has been stated that complete thyroglossal fistulas do not occur; however, in view of the findings in one of the cases reported it appears that, although complete fistulas may be rare, they do occur.

DISCUSSION

Dr. Harry L. Pollock: Dr. Russell has discussed the embryology of these branchial clefts, so there is no need of reiteration. All that one is interested in clinically are the first and second branchial clefts, from which most of the branchial cysts or fistulas arise. I was a little surprised that Dr. Russell did not mention the fistulas occurring in front of the tragus, where I find them more frequently than at any other site. They are, no doubt, from the first branchial cleft. These small fistulas are not very deep, and they can be easily removed as a rule, but I have had two cases in which an operation was done on the mastoid for such a cyst. The opening was in front of the tragus, and the fistula led back of the ear, with a large swelling over the mastoid. In one case this was opened for a mastoid infection. It was simply opened and drained, and it continued to drain and was not cured until the entire cyst was resected. I saw the patient after the mastoid operation.

In the second case I was fortunate in seeing the patient originally, and dissected out the cyst and obtained a primary closure.

Dr. Russell is correct in stating that the cysts are all surgical. Unfortunately when one sees the patients—at least most of those whom I have seen in years gone by—they have been in the hands of general practitioners or general surgeons

who have not recognized the cysts and have simply opened and drained them. After they are once opened and infected they are very difficult to cure.

Unless one extirpates the entire tract, no permanent result is obtainable. If seen in a primary stage, the cysts should be dissected out cleanly, but this is not an easy task, as they often extend to the base of the tongue or to the cecal foramen, and at times it is necessary to resect a portion of the hyoid bone. I have never seen a cure of one of these cysts or fistulas follow the injection of an irritant. These fistulas do not follow a straight line but give off numerous small branches, making it impossible for the caustic to reach each and every one of the small recesses, thereby defeating the purpose of the injection to destroy all the lining membrane.

I wish to show photographs illustrating two cases of branchial cyst which have recently come under my observation.

CASE 1.—A man, aged 26, had been operated on for bilateral mastoiditis at the age of 14 years by Dr. Beck and myself (radical mastoidectomy on one side and simple on the other). He made an uneventful recovery from these operations, although at times the cavity radically operated on filled with cerumen and detritus and occasionally had to be looked after. About two years ago a large swelling suddenly occurred on the side of his neck and the back of the ear where the simple mastoidectomy had been performed. The swelling was not red or tender. Examination showed a large fluctuating mass, easily movable and not tender. A small amount of fluid was aspirated which contained cholesterol crystals and some epithelial cells. Therefore a diagnosis of branchial cyst was made and immediate operation advised. Under general anesthetic this was done and the cyst, oblong in shape and measuring 3½ inches (8.9 cm.) in length and about 1¼ inches (3 cm.) in diameter, was removed; it was attached in the immediate region of the second cervical vertebra. Uneventful recovery followed, and no recurrence has been seen to date.

CASE 2.—A man, aged 48, was referred to me about a year ago by a general surgeon for examination of what he termed "the largest tonsil he had ever seen." The condition had been present for the past seven years. I found a fluctuating tumor approximately the size of a tangerine on the right side behind the posterior pillar, pushing the tonsil and posterior pharyngeal wall forward. A small amount of aspirated fluid showed cholesterol crystals and epithelial cells. A diagnosis of branchial cyst was made, and removal of the cyst by the external route was advised. The surgeon, however, decided to aspirate and inject weak solution of iodine, which had been done four or five times, but today I saw the patient again and the tumor is practically as large as on first examination.

I desire to thank Dr. Russell for bringing this subject to attention again. Sebaceous and dermoid cysts occur occasionally in this region, but by puncture one can always make a differential diagnosis.

DR. ALFRED LEWY: I disagree with Dr. Pollock regarding the little dimple that occurs at the tragus, which he said is easy to remove. I have treated a few, and they do not easily heal. If infection occurs it is hard to manage.

DR. ROLAND D. RUSSELL: I disagree with Dr. Pollock and Dr. Lewy on the question of anatomy. The title of the paper is "Cysts and Fistulas of the Neck"; the tragus appears in the neck very seldom.

I also disagree with the statement that the diagnosis is always easy. One of these cysts I took to be a submaxillary cyst because it lay in the submaxillary triangle, quite to one side, but it proved to be a typical thyroglossal cyst attached to the hyoid bone. In the case of the submaxillary cyst, it lay in the midline and was mistaken for a thyroglossal cyst.

TUBERCULOSIS OF THE MIDDLE EAR IN PULMONARY TUBERCULOSIS. DR. IRVING MUSKAT.

After a careful study of a large group of patients the conclusion was reached that tuberculosis of the middle ear and mastoid as seen in the adult with active

pulmonary tuberculosis, because of its insidious, painless onset, has not received the attention it merits.

Tuberculosis of the middle ear and mastoid presents an added focus to the pulmonary disease, interfering with the building up of the bodily resistance which is essential in controlling the disease.

The focus in the mastoid, which is often extensive, can (unlike the pulmonary focus) be readily eradicated by the classic radical mastoid operation under local anesthesia. Patients with active pulmonary tuberculosis improve in health following the eradiation of the mastoid focus.

DISCUSSION

DR. ALFRED LEWY: In this community tuberculosis of the middle ear and temporal bone is rarely recognized outside of institutions for patients with tuberculosis. Even at the Illinois Eye and Ear Infirmary, where cultures and tissues are examined in all suspicious cases, its recognition is very rare. One may, however, suspect it from the painless onset and rapid loss of hearing, especially if the bone conduction is shortened. Only once have I seen multiple perforations which I believed were due to tubercles. On the other hand, I have several times seen perforations behind and before the handle of the malleus without the condition being tuberculous.

The surgical management of accessible tuberculosis has made great strides in recent years, and Dr. Muskat's paper is an important otologic contribution. It is further valuable because it shows that tuberculous patients with chronically discharging ears, regardless of whether the otitic complication itself is tuberculous, are in most cases fairly good surgical risks under local anesthesia, the advantages of which I can also attest in other conditions in which general anesthesia is undesirable, for instance, an unresolved pneumonia. His observation that the patient's general condition improves after the mastoid operation is worthy of note, and this whether or not the condition of the ear is itself tuberculous, which is often difficult to determine bacteriologically.

Dr. Muskat is to be congratulated on this otologic contribution as well as on his simplification of the technic of superior laryngeal nerve resection for painful tuberculosis of the larynx.

DR. FRANCIS L. LEDERER: It seems that many have operated on ears in patients who had tuberculosis without knowing that the patients had it. At least observations on cases at the City of Chicago Municipal Tuberculosis Sanitarium indicate that many in which radical mastoid operations have been done have been cases of pulmonary tuberculosis. In the light of present day surgery I do not think that one needs to discuss this subject from the point of view of whether or not one can practice operative intervention. Several otologists, including Dr. Muskat, have brought out the possibilities of operative procedure. This presentation tonight is not new, as the essayist has frequently published articles along this line.

A number of points need to be brought out, for all do not seem to be discussing the same pathologic picture of aural tuberculosis, and this, after all, is most essential for complete understanding. When Dr. Muskat discusses his material at the Cook County Infirmary, Oak Forest, he speaks of the adult type (which, according to some, is but a recrudescence of a primary infection in childhood), and when he says he has not observed facial paralysis, he qualifies it, stating that this condition occurs mainly in children. As you know, Turner found 50 per cent of tuberculous running ears in children under 1 year of age. While the disease is certainly not so frequent in adults, it occurs more often than is appreciated. The pasteurization of milk and inspection of cattle had much to do with lowering the number of cases of tuberculous otitis.

To understand this subject, it is necessary to acquaint oneself with two forms of middle ear tuberculosis, viz., a slow and a rapid form. The tendency of

most clinicians is to consider tuberculosis of the ear primary when it is localized to the lymph vessels and the regional glands, where, in most instances, it has arrived by way of the pharynx via the eustachian tube or lymphatics. In other words, it is well to consider it as a primary disease of the mucosa of the middle ear. The type that Dr. Muskat has been concerned with is the one with the insidious onset; he, as well as others, has not had the good fortune to observe this early enough to see the typical ear drum picture. I have, with my associates, seen the condition very early, and have observed a camphor ice appearance of the drum. On a subsequent examination a single perforation could be seen, and a number of days later, a second perforation and perhaps a third. I realize that in office practice or in institutions where patients with old and far advanced disease are housed, one sees multiple perforations after they have coalesced, and there is no way to judge whether the condition is of tuberculous origin. It is essential to consider three anatomic types, viz., a miliary form leading to bone tuberculosis, a granulating or proliferating form (fungoid) and a caseous form (infiltrative or necrotic). In the miliary type there are tubercles in the submucosa of the middle ear that cause a periostitis or osteomyelitis by continuity of structure or by the phlebitic route. The so-called typical pale granulations of almost mulberry character occur in the granulating form of tuberculosis. This is described as an infiltrative or proliferative tuberculosis of the middle ear. The caseous type, with destruction and sequestration, occurs in the rapid type of tuberculosis; it is not of sudden onset but is the type in which there is sequestration.

The essayist has covered the essential diagnostic signs by inference rather than by proof, for he states the points, such as multiple perforations, granulations and positive evidence by inoculation into guinea-pigs, and then states that he has never observed them or that he does not employ them. While much dependence can be placed on the characteristic painless onset, it is not in itself diagnostic, and furthermore I have observed the acute form coming on with pain.

As far as surgical intervention by mastoidectomy is concerned, I am sure that all should follow the same principles in operating on the mastoid in patients with tuberculosis as they would follow in their patients in general. However, I am not so certain that if I had a patient with a suppurating ear I should consider it as a focus nearly as much as I should a larynx that is interfering with breathing and the essential function of swallowing. I believe it was the late Dr. Stuckey who went through many institutions for patients with mental diseases and cleaned up the mastoids as foci of infection on the basis that the mastoid condition was retarding progress. To my mind there is a question as to whether the mastoid constitutes a focus of infection as does a larynx or even a sinus or a tonsil. The number of complications that are observed in tuberculosis is surprisingly small when one considers the destruction that goes on in that disease.

As to the technic of the operation, I am sure all agree that it would be best not to operate on a tuberculous patient under general anesthesia. If tuberculous patients survive the many types of operations on the chest they will certainly survive operation on the mastoid. On the other hand, I wonder whether the patients on whom Dr. Muskat performed this radical mastoid operation were given the benefit of conservative management. I know from the great number who have been operated on and who as a consequence have come into the City of Chicago Municipal Tuberculosis Sanitarium that, had many of you known of the presence of this infection, you would have refrained from operating and given more thought to treatment. That, of course, does not mean that many of those operated on have not been healed. I believe that in an institution I should resort as a routine to all conservative means before I should attempt a radical mastoid operation. Perhaps 85 per cent of chronically discharging ears get well under conservative treatment. When you speak of the 15 per cent that you cannot clean up by such means, you speak usually of ears whose suppuration is due to tuberculosis, syphilis, cholesteatoma and malignant disease. In my experience with tuberculosis in a sanatorium housing well over a thousand patients with this disease I do not see fit to indicate

radical operation on the mastoid any more frequently than most of you do in the conduct of your private practice on chronically discharging nontuberculous ears.

Dr. Joseph C. Beck: As Dr. Lederer has just said, there must be a different attitude, and I think that in discussing this subject the members are discussing different forms of tuberculosis, in spite of the fact that one follows a more conservative and the other a more radical routine. In cleaning up chronically infected ears in patients with tuberculosis, whether the otitis is due to pyogenic or to tuberculous infection, I feel a radical operation must at times be necessary, especially in the adult ear where constant absorption from the ear is going on. In analyzing foci of infection I think the systemic absorption from the ear is probably much less than that from the sinus, the tonsil and other areas in the body, but there is no reason to doubt that from the ear there is vascular and lymphatic drainage just as from other areas. The great difference is in the age of the patient. As Dr. Lederer brought out, statistics show that in young patients facial paralysis is much more frequent and intracranial complications also much more common. I am sure that in reviewing the literature one must find many cases of meningitis reported that are of tuberculous type. Meningitis is more common in those in whom there is no evidence of tuberculous disease, yet in many instances tuberculosis has been shown in the cell count in the spinal fluid. I should like to have the doctor report the result of his study in regard to tuberculous infection in young persons. My experience has not been great in regard to finding tubercle bacilli. Dr. Dryer and Dr. Cox have tried to bring out tubercle bacilli by special means, but it is very rarely indeed that the organisms can be found. I know that in cases of sequestration the sequestra should not be removed, for they will be extruded in time, and if they are removed there will be infection. If there is such extrusion, you may be sure that at one time there was an active infection. In one case of tuberculosis of the mastoid, in which tubercle bacilli were found, there was a tic douloureux. It must have been tuberculous.

I should like to know whether patients presenting aural tuberculosis have not received treatment by different types of actinotherapy.

Dr. T. C. Galloway: I believe that tuberculous otitis media is rather common in dispensary practice in this community. European clinics have reported much higher percentages of such infection, as they have also of bone, joint and gland tuberculosis. The latter forms are usually held to be due more frequently to the bovine organism where milk is not pasteurized. The question was raised how often outside of sanatoriums tuberculous otitis might be caused by the bovine organism.

Dr. Sherman L. Shapiro: I wish to ask the essayist whether he considers the eustachian tube as the common source of infection for tuberculosis of the middle ear, and what practical value he places on inoculation of the aural secretion into guinea-pigs as a means of diagnosing tuberculosis of the middle ear.

Dr. Roland D. Russell: I should like to ask Dr. Muskat to elaborate a little on his method of obtaining anesthesia of the tympanum. I do most of my operations under local anesthesia, but have to admit that when I get near the tympanum or in it there is some pain.

Dr. Alfred Lewy: On the subject of indications, there is one indication that is not dwelt on much in textbooks which I consider one of the most important in mastoid surgery, and that is the social indication. Before one decides whether to use radical or conservative measures one has to find out whether the patient will, or can, have the conservative treatment that will save him from operation. In private practice I rarely do a radical operation, but in dispensary practice it is one of the most common procedures, for patients come in there who have been neglected and who cannot have conservative treatment because of the time that they would lose from work.

Dr. Irving Muskat: The work represented in this study was done at the Cook County Tuberculosis Hospital, Oak Forest. The subjects were adults with active pulmonary tuberculosis who, in addition, presented the problem of aural

tuberculosis. The classic findings of tuberculosis of the ear were present, although no inoculations into guinea-pigs were made. There was no question about the diagnosis. These patients improved in health after the local radical mastoid operation, which often revealed extensive disease. They gained in weight and strength, and I believe that this operation should be performed as a general measure. It is important to remember that it is the products of tuberculous destruction, a pathologic catabolism, that rob the patient of his vitality. This pathologic catabolism adds toxins to the body and thus further diminishes the body reserve which is being depleted by the coexisting pulmonary focus. To me, clinically, there remains little doubt that the mastoid focus of tuberculosis contributes to the depletion of the patient's protective forces. The area of disease need never be extensive. A patient need not have an extensive destruction of lung before he shows profound effects of the tuberculous toxins. His aural tuberculosis is an added drain on the body's protective forces. The eradication of the tuberculosis of the mastoid and middle ear removes this added burden. Unfortunately the eradication of the disease of the lung is not so easily accomplished.

At this point I may consider Dr. Beck's question regarding the use of actinic rays in the treatment of aural tuberculosis. There are many reports on this subject, but those who have had a wide experience believe that it is the general reaction of the body to exposure to the rays and not the local application that brings about improvement. It is impossible to conceive how the local use of such rays can bring about a healing of extensive deep-seated tuberculous lesions in the ear, nose or throat.

As stated before, I have given the clinical picture of aural tuberculosis in the adult with active pulmonary tuberculosis. I am familiar with the work Dr. Lederer has reference to regarding the necrotic and fulminating types of mastoid tuberculosis, which has been reported so well by Logan Turner and Fraser. But this survey was of aural tuberculosis in children. I have not encountered such types in adults.

In this connection I may consider the subject of facial paralysis. No doubt facial paralysis occurs more often in children because of anatomic reasons and because of the more destructive nature of mastoid tuberculosis in children. However, in adults I have seen it only once, and men like St. Clair Thomson, who has had vast experience, have encountered it rarely.

Regarding multiple perforations of the drum, I repeat that those who have had wide experience believe they are uncommon. As to mulberry granulation, it is not important. It occurs but as a rule is not diagnostic of tuberculosis. It occurs also in pyogenic cases.

As regards tuberculous meningitis, it occurs, but I have not encountered it. Logan Turner and Fraser reported 2 deaths (5 per cent) in children following operation for mastoid tuberculosis. I am in accord with them, however, that tuberculous otitis media does not appear to give rise to serious intracranial complications to any marked extent, though tuberculous pachymeningitis externa is frequently met with. Tuberculous meningitis is usually found post mortem in persons operated on for tuberculous otitis media.

The question of bovine tuberculosis has also given rise to much controversy. Its status, however, so far as these studies are concerned, may be briefly summed up as follows: The bovine type of tubercle bacilli rarely causes pulmonary tuberculosis and is practically a negligible factor in adults. In children, bovine infection consists invariably in tuberculosis of glands, skin, bones, joints and intestines. In children, therefore, aural tuberculosis may arise by way of the blood stream, whereas in adults with open pulmonary tuberculosis the avenue of infection is from infected sputum through the eustachian tube. That aural tuberculosis may be transmitted by way of the blood stream in the adult from another focus is plausible, but almost always it is by infection directly through the eustachian tube.

To answer the question regarding pain during the local radical mastoid operation, I may state that there is pain only when the antrum and middle ear are reached, but this is well controlled by cocaine pledgets.

Regular Monthly Meeting, Feb. 4, 1935

FRANK J. NOVAK, M.D., *President, in the Chair*

INFECTIOUS MONONUCLEOSIS. DR. I. DAVIDSOHN (by invitation).

The confusion in the terminology, classification and clinical concepts of infectious mononucleosis is best explained by the history of the disease and by the marked variations in its symptomatology and epidemiology. The disease is presented as a distinct clinical entity. It may occur in the form of epidemics or sporadically, and is characterized by: (1) fever; (2) enlargement and tenderness of lymph nodes which, according to the location of the nodes, give rise to marked variations in the clinical picture; (3) skin eruptions; (4) sore throat with ulcerations and membranes which lead occasionally to a mistaken diagnosis of diphtheria; (5) a characteristic though not specific blood abnormality, which is a mononucleosis with changes in the lymphocytes consisting of (*a*) hyperplasia, (*b*) hypertrophy, (*c*) anaplasia, (*d*) plasmocellular metamorphosis, (*e*) monocytic deviation and (*f*) vacuolar degeneration of the cytoplasm; (6) a tendency to recurrences, and (7) the presence of heterophilic antibodies (agglutinins for sheep red blood cells) in the blood which, while theoretically not specific, are under certain conditions quantitatively and practically specific, so that a new and effective means is available for offering a good prognosis in certain distressing conditions, for eliminating the use of diphtheria antitoxin in others, and occasionally for protecting patients against unnecessary surgical procedures. Every one of the seven features is discussed in detail, with emphasis on the fact that many patients with pharyngeal lesions are first seen by laryngologists. The technic of a test for heterophilic antibodies is outlined, and the subject of heterophilic antigens and antibodies is briefly reviewed. The importance of the test is illustrated in a report of 3 cases, in 2 of which findings were manifested in the throat which were of interest to laryngologists.

DISCUSSION

DR. H. G. PONCHER (by invitation): I am going to set a precedent by agreeing with the essayist. I think Dr. Davidsohn gave as masterly a discussion of the subject as any I have ever heard, and I shall try merely to emphasize a few things that I think you are particularly interested in.

Outside of the pediatric group, the cases I have seen for the most part have been those studied with otorhinologists and laryngologists. Paradoxical as it may seem, most of the difficulty in these cases started when the patients were subjected to a complete hematologic examination. The blood changes were so atypical that in many of the cases they were diagnosed as leukemia. A considerable amount of experience is necessary before one can distinguish the morphologically changed cells characteristic of infectious mononucleosis from the anaplastic types seen in leukemia. One fact stands out and that is that the immature appearance of the cells seen in infectious mononucleosis is more apparent than real. In spite of the basophilia of the cytoplasm the nucleus does not have the structure of the nuclei of immature cells. However, when skilful laboratory aid is not available the serologic test is more reliable, as Dr. Davidsohn has pointed out. A mistaken diagnosis of leukemia is serious because of the prognosis. Clinically mononucleosis presents less of a problem, but there are a few points which should be borne in mind. The anginal type is of particular interest to the otolaryngologist. It occurs most commonly in persons between 10 and 25 years of age. Many of the patients have what looks like a diphtheritic membrane on casual inspection. The edema about the pharynx, soft palate and peritonsillar region may be striking and painful. Suppuration may appear imminent, but the consoling feature in this disease is that it rarely happens. I have never seen a case in which it occurred and have never read about one in which it did. Further, I have never seen a membrane in the nose or larynx. The striking clinical feature of the disease is the lack of correspondence between the constitutional symptoms and the local pathologic

changes. There may be extreme discomfort locally because of the edema, but in spite of the fever the patients do not appear critically ill. As a rule they begin to improve when the membrane separates. Such a condition is described in contemporary European literature as monocytic angina or as a diphtheria-like condition with a lymphatic reaction. I believe the cases described thus represent the anginal form of infectious mononucleosis. Unquestionably many of you have seen such cases. From my limited clinical experience with such cases there does not appear to be anything characteristic about the local changes in the throat other than the absence of suppuration and a self-limited clinical course. The only specific features of the disease are the serologic reaction and the absolutely atypical lymphocytosis. Perhaps a more careful clinical study will reveal clinical findings which are characteristic. The importance of recognizing this disorder is mostly from the standpoint of prognosis and perhaps treatment. Infectious mononucleosis improves spontaneously, and complications are rare. There is always the temptation to help the bone marrow in patients who have infection and lymphocytosis. But the patients do better if a minimum of symptomatic treatment is given. Against the idea of more severe involvement of the blood-forming organs is the fact that the patients rarely have anemia as a result of this disease. Leukemic patients are usully anemic before leukemia is apparent hematologically and clinically. The introduction of the serologic test has added a new impetus to the study of infectious mononucleosis. Just what specific significance may be attached to the presence of heterophilic antibodies in the blood of patients with this disease remains to be demonstrated. It is an interesting immunologic phenomenon, and its discovery is a practical contribution to the study of the disease.

Dr. Robert Sonnenschein: My knowledge of this subject is in inverse ratio to my interest in Dr. Davidsohn's presentation. The great work he has done is well known, and he has presented it in a logical manner. Thirty years ago I had the pleasure of taking a course in hematology with Dr. Turck of Vienna, but I think his efforts were wasted on me. You know I am a stickler for honesty in medical work and think justice should be done where it is due. Speaking of Vincent's angina, I was glad to hear Dr. Davidsohn speak of Plaut-Vincent angina. As a matter of fact, Plaut published his work three years before Vincent, but most persons refer to the disease which he described as Vincent's angina.

One thing that impressed me was the statement that the throat condition is often merely a manifestation of a general condition and not of a purely local one. One is often prone to consider the nose and throat the main sources of the disease with which one is confronted. I am reminded of an eminent gastro-enterologist who was inclined, no matter what the patient complained of, to give him one or more gastric lavages. I think this paper is a notable contribution to the records, and I am deeply grateful for its presentation.

Dr. George J. Dennis: I wish to mention a case of infectious mononucleosis which I saw about three months ago. A man previously healthy came to the office with an infected throat and no special symptoms except pain on swallowing. A gland on the side of the neck was large, but that was the only one palpably hypertrophied. I sent a specimen to the laboratory for culture, and the culture was reported as gram-positive with pneumococci arranged in chains. The blood count was made in this laboratory at the same time and the report was acute leukemia. I was a little uneasy and sent the patient to the hospital. He experienced more pain in the throat and reached the point where he could not swallow even water for some hours. He had a membranous formation over the pharynx and a pinpoint-sized mass over the tonsil. I had another blood count made by the pathologist at the hospital, who returned a diagnosis of infectious mononucleosis. His reason for this diagnosis was that the blood count showed about 18,000 leukocytes, of which 40 per cent were monocytes and about 40 per cent polymorphonuclears. It was realized that the patient was a young man and that he would recover from this infection. I have watched his blood, making a count about once a week, for two and a half months, and I find that he still has mononucleosis. The lowest count has been 48 per cent, with polymorphonuclears 55 per cent.

DR. H. L. POLLOCK: I have had some experience with mononucleosis. My son, when a medical student, contracted sore throat and enlargement of a gland. I thought it was a glandular fever and decided to have a blood count made. This is somewhat like having a thermometer around the house—you take your temperature and get scared. I had the blood count made and was alarmed when the report came back. That count was made by a technician, so I had the count taken again by one of the best hematologists in the city, and he immediately informed me that the condition was acute infectious mononucleosis and that the boy would soon be all right. I have had a blood count made every few months and so far, in a period of six or seven years, there has been no return of symptoms.

I am sure that one should be very careful about who makes the blood count, and I think one is better off if one makes a clinical diagnosis rather than a blood count.

DR. SAMUEL J. PEARLMAN: I hope Dr. Davidsohn will supply a paper for publication, so that this information which is so desirable and which it has been so pleasurable to hear will be available to laryngologists everywhere.

DR. I. DAVIDSOHN: I wish to thank Dr. Poncher and the others who discussed the presentation for their interest and their kind words.

There are additional details which may help in differentiating some of the cases. Dr. Poncher brought out a very important point in stating that patients with this condition show no essential changes in the red blood cell picture. The lowest count was 3,000,000, which I saw in a young girl.

Another very important diagnostic point is the total number of white cells. As I said, the highest recorded count for an adult is 40,000 and for a child 60,000. A count much above 40,000 speaks in favor of leukemia and against infectious mononucleosis.

The continued mononucleosis is a very striking regular finding, and cases are on record in which it was in evidence for a number of years.

The experience of Dr. Pollock is not uncommon in families of physicians. The condition is common in educational institutions, such as colleges and medical schools, and among nurses. It may be that students and nurses have opportunities to see a doctor more readily than others. Most of the other patients probably wait a few days and get well without a doctor.

It is rather difficult to be more specific than I have been about the factors that make infectious mononucleosis a clinical entity. The final link in the chain which was necessary to stamp it an entity is the test.

I wish to point out a special opportunity for laryngologists in the further research in this disease. There are some authors, particularly in Germany, who claim that the anginal form is due to the Plaut-Vincent micro-organisms. Friedemann and his associates wrote a number of articles on this. According to their work, it is not sufficient to take a smear from the surface of the lesion or of the tonsil. One must insert a platinum loop into the tonsillar crypts to secure the specimen. That is where they find these micro-organisms. There is an opportunity for laryngologists to study a large number of cases of ulcerative lesions in the throat and to compare the bacteriologic findings in the throat with the morphologic and serologic findings in the blood. I doubt very much that there is a relation between the presence of the Plaut-Vincent micro-organisms in the throat and infectious mononucleosis.

THE SPHENOID ON PARADE. DR. JOHN A. CAVANAUGH.

(The author reviewed the interesting eras of the history of the sphenoid sinus, beginning with 3500 B. C., and then offered the following comments for consideration.)

Some years ago I tried to explain the importance of sphenoid sinus disease and the urgency of not neglecting it. I reported the first vacuum sphenoid sinus case. I emphasized the significance of the pharyngoscope and the success attained in probing the sinus in every case but one. There is always the necessity for

keen and painstaking care in making diagnoses. My work included the first injection of an opaque substance into the sphenoid sinus in the living patient for the purposes of roentgenography, with the valuable assistance of Dr. Hubeny, who directed the roentgenographic work. I have given little attention to the use of the x-rays in this journey into the past since every roentgenologist has a method of his own. A small hooded light, of my invention, was passed into the sphenoid sinus after its ostium had been dilated, for transillumination; it aided materially in judging the thickness of the partition between the sinuses and the relative size of both cavities if the partition was thin. Irrigation of the sphenoid cavity is dangerous until a free opening is made. The mucous membrane of this cavity seems to be especially sensitive to inflammatory changes. When it is necessary to remove the anterior wall, the field must be clearly seen. The middle turbinate, or at least the posterior half of it, should be removed. The sphenoid opening never closes after this operation, and this fact can be attributed to but one thing: the removal of the anterior wall in toto. To do this, the posterior ethmoid cells and the lower part of the thick anterior wall must be removed. The only way in which this can be successfully done that I know of is by the use of the Cavanaugh hooded bur. It is important that the overhanging mucous membrane at the lower part of this wall be removed; if allowed to remain, it will reconstruct itself and close the anterior wall. When this wall is removed low it is advisable to ligate the sphenopalatine artery. It is absolutely necessary to locate the sphenoid cavity, for I have seen cases in which the cavity operated on was a displaced ethmoid cell, while the sphenoid sinus remained untouched.

I should like to draw attention to the position of the basilar process of the sphenoid bone, as to whether it is on a vertical or on a horizontal plane. When this process is horizontal, there is more liability to Dorello's syndrome.

On a trip through the Orient in 1928 I was surprised to learn how little was known about the sinuses, especially about the sphenoid sinus. In Calcutta, at the Medical College of Bengal, an English doctor, Colonel Copinger, head of the ophthalmologic department, which was well organized and disciplined, showed me an x-ray picture displaying a probe passing through the sphenoid sinus and into the cranial cavity without causing any apparent cerebral symptoms.

DISCUSSION

Dr. H. L. Pollock: After hearing this most illuminating paper on the history of the sphenoid sinus, I feel that there is very little left to discuss. It has taken a great amount of work to go into the literature as Dr. Cavanaugh has done, and the members are all grateful for the "trip" he has given them.

I have the firm conviction that of all the sinuses the sphenoid is the most neglected. I did not have an opportunity to read the paper thoroughly, but I think Dr. Cavanaugh made the statement that he can probe the sphenoid sinus in almost every case of disease of this cavity. He probably possesses more skill than the majority of otolaryngologists. I think it is simple to enter the sphenoid sinus after the whole inside of the nose has been taken off, but I am still of the opinion that it cannot be done easily with the middle turbinate intact.

Dr. Cavanaugh spoke of pulsating sphenoiditis. I reported this condition before this society in 1921. I showed the patient and a roentgenogram in which the probe was seen entering the sphenoid sinus. The patient was a young woman who after a complete operation had a pulsating discharge from the sphenoid sinus, and I was able to pass a probe about 2¾ inches (6 to 7 cm.) into the sinus. The roentgenogram showed that the process in the sinus had eroded posteriorly and gone into the basilar projection of the occipital bone; the probe could be seen extending almost to the foramen magnum. The patient is still alive. When Dr. Beck and I were together, we saw several patients with pulsating sphenoiditis, and their sinuses were the most difficult to restore to a normal condition. The pulsation was produced by the carotid arteries, and we attributed that to a dehiscence or some other defect in the sphenoid wall. As you know, it is surrounded by the cavernous plexus. We did not obtain pulsation all the time, for it must be transmitted from the carotid artery, but when the internal jugular vein was pressed,

the impulse was carried through the cavernous sinus into the sphenoid sinus. The condition in most of these cases, we discovered, was on a syphilitic basis, and on antisyphilitic treatment practically all the patients recovered.

There is so much divergence of opinion that it is difficult to discuss the paper, but I still believe that the sphenoid is the most neglected of all the sinuses. The preferred method of treatment is to remove the middle turbinate and then the ethmoid cell, take down the anterior wall and then part of the floor. There are some complications that Dr. Cavanaugh mentioned, some ocular symptoms. I have had several patients with bulbous exophthalmos whose condition was diagnosed as suppurative sphenoiditis. Some recovered after the sphenoid had been cleaned out, and some were examined post mortem.

Dr. Maximilian J. Hubeny (by invitation): Dr. Sonnenschein brought out a very important matter, and that is intellectual honesty. Because of a certain amount of enthusiasm one sometimes misleads others into doing things that should not be done. I think one should know when things should not be done as well as how to do them. Dr. Cavanaugh asked me during dinner why roentgenologists have so many different technics. I think the answer is that no known method is satisfactory, and all are looking for a better method. The sphenoid sinus is the most unsatisfactory of the sinuses to deal with. There are a good many reasons for this: First, the sinus is located so far back that when it is projected on the film no satisfactory image can be obtained. Another physical thing is—if it is rather elemental, I hope you will excuse me—that if you take a penny and put it on the bottom page of a book and put the book next to the x-ray film and make a roentgenogram the penny will show rather well, but if you put it in the middle of a large book it will not show well. First, it is too far away and, second, it is surrounded by a great deal of density. For a similar reason the sphenoid sinus is very unsatisfactory to roentgenograph. There are many angles, and all should be utilized. It involves the expenditure of much time, effort and money, and sometimes I wonder whether it is worth while. One does get some satisfactory results occasionally.

One method to use preferably for the sphenoid sinus is the modified Pfahler technic. This requires two similar projections: First, the superciliary ridge, the malar process and the nose are in contact with the cassette, and the central beam is projected above the tragus of the opposite ear; second, after this exposure is made, the opposite side is similarly roentgenographed. The purpose is to project the sphenoid sinuses through the orbital cavities. The value of the interpretation is in direct proportion to the thoroughness of the examination and the interpretative skill. However, clinical support, after all, is the most vital.

As a warning, I should suggest that artefacts be avoided; this applies particularly to roentgen examinations of frontal and antral regions. To illustrate: A film may have a peculiar characteristic of haziness which may fall into the outlines of a sinus, and this opacity may be construed as pathologic; this was appreciated over twenty-four years ago, and consequently, even at that time, because of the inadequacies of equipment and the paucity of technics, an effort was made to avoid this simple pitfall; this was accomplished by placing two glass plates (in those days there were no films) one on top of the other and exposing them simultaneously; then one plate could be checked against the other. Today, with better facilities, the same purpose can be accomplished more efficiently by taking a postero-anterior projection and Water's projection.

I am grateful to Dr. Cavanaugh for giving me the opportunity, in 1919, to work with him on the injection of opaque substances into the sphenoid sinuses. One should not become too enthusiastic about this method, whether performed by injection or by suffusion.

Dr. Samuel Salinger: I enjoyed this "trip" very much despite the fact that I'm a poor traveler and easily become seasick. Dr. Cavanaugh covered a lot of ground, and yet it would be easy to point out additional data in which the sphenoid sinus figures as the infective focus. Eagleton said, "If you have a Pneumococcus

type II meningitis in association with an ear infection look to the sphenoid for the real source of the trouble rather than to the ear." Again, there are many who claim that certain types of insanity and various psychoses are due to infection of the sphenoid sinus. Finally, only recently in the German literature there appeared an article on a group of cases of Ménière's disease in every one of which the author found infection of the sphenoid sinus or of the spheno-ethmoid recess as the etiologic factor. And so, it seems, if one is to follow the argument to its logical conclusion, one will find that the sphenoid is at the bottom of the present depression and more than likely is responsible for the failure of the N. R. A.!

This review of Dr. Cavanaugh's is of great importance if one will take the time to study it and evaluate its content in the light of experience.

DR. ROBERT SONNENSCHEIN: This paper was of great interest to me, for I am always interested in history of any sort, and particularly in medical history. As many of you are aware, my hobby is the collection of medical portraits, engravings and old books on the ear, nose and throat. Had I known this paper was to be historical I should have brought down some items that might have been of interest to you. I well remember hearing Professor Breasted, before the Institute of Medicine a number of years ago, give a paper on the Smith papyrus, in which there is an excellent report of work by the Egyptians about 3500 B. C. They recognized almost all the diseases we do, except those which have become known through the microscope, and used many of the drugs we now have.

I think that the reason the sphenoid sinus was not understood was because dissections were not available generally. A few sections were made secretly, but such work was not tolerated until the enlightened Frederick II of the Holy Roman Empire granted to Italian universities about 1224 the privilege of making two dissections a year.

Mondino, I think, first made public dissections and demonstrations before students, in 1315. Then Vesalius stole the bodies of executed convicts and published his work on anatomy in 1543.

With reference to probing the ostium of the sphenoid sinus, I think it can be done in many cases. My associates and I have not been so successful as Dr. Cavanaugh, but often infraction of the middle turbinate laterally will permit one to find the ostium.

I am glad that so large a group was able to hear this paper relative to medical history. As a rule, you know, if a tonsil instrument is to be exhibited, a great crowd will gather, because it can be turned into money. There is an old saying to the effect that "man cannot live by bread alone," and laryngologists do not need to live by tonsils alone. I hope the society will have many more papers of this type.

DR. JOSEPH C. BECK: I should be ungrateful if I did not rise to thank Dr. Cavanaugh for mentioning my name in connection with the sphenoid sinus.

The point Dr. Cavanaugh made regarding the possibility of diagnosing a pulsating artery was interesting. I have a stereoscopic picture showing that the greater part of the cranial portion of the carotid artery is in the sphenoid bone, and one can readily see that in working on the sphenoid sinus one might easily injure the carotid artery. In those cases of pulsating sphenoiditis which we found by compressing the vessels of the neck, while one was doing this and the other watching within the nose in the sphenoid area, a quantity of pus would well out and one could see the pulsation, and when the pressure on the side of the neck was released, that symptom stopped. This pathologic observation was verified by roentgenologic examination, which showed definite necrosis. In those cases I was able to show the findings of the diagnostic probe. The patient was placed in the recumbent position with the probe resting in the sphenoid sinus, and a definite pulsation was observed in the spontaneous movement of the probe. We diagnosed those cases as syphilitic sphenoid osteitis.

I told Dr. Cavanaugh that I think there are two main reasons why the opening in the sphenoid sinus closes rapidly: One is that it has not been opened properly. The other is that in the anterior wall of the sinus where the narrowest part is

located there is a greater production of bone following operation. That is what happens following nasal work in the antral and frontal sinuses. All of you are acquainted with the difficulty of trying to close an opening into an antrum which has been opened by a dentist. That is a common experience with all.

I was much interested in the historical part of the paper, and what Dr. Sonnenschein said regarding the attendance tonight is also of much satisfaction to me. The title of the paper gave no clue to the material in it. I know many things were omitted because time would not permit going into them, but I am glad that I heard the paper and wish to compliment Dr. Cavanaugh on going to so much trouble in looking up the literature.

DR. WALTER H. THEOBALD: I wish to comment on this excellent presentation, which I enjoyed greatly.

I find it is not difficult to probe the sphenoid sinus; that is the technic which I always use in locating the sinus for the purpose of irrigation. I take it that Dr. Cavanaugh is not prone to irrigate the sinus much, but I practice this procedure so as to find out what is going on inside this cavity. I wish to bring out one point, and that is the simplicity of the technic with which one can find the sphenoid sinus; although the method does not always locate the sinus, it gives one a good idea of where it is located (illustrating on the blackboard): A probe directed upward and obliquely across the middle turbinate will arrive a little median to the sphenoid sinus, in this way (indicating).

DR. DWIGHT C. ORCUTT: Being a mere ophthalmologist, I hesitate to rise in this august body. I wish to call attention to the close proximity of the optic nerve tract and the number of times that neuritis of this nerve is directly traceable to disease in the sphenoid cavity. Dr. Cavanaugh, in his modesty, did not mention several cases which we studied together in which the results were excellent. We took several patients who were almost blind and by relieving the pressure in the sphenoid sinus by drainage obtained a return of vision in two instances to full 6/5. I have had several cases of this character.

All this talk about getting a probe or cannula into the sphenoid sinus is interesting, but I consider that it is one of the easiest sinuses to enter, and I think it should be approached very much along the lines Dr. Theobald has pointed out.

DR. JOHN A. CAVANAUGH: The rules for locating the sphenoid ostia, as outlined by Dr. Theobald, cannot be followed in all cases, since the openings vary in their location.

I should like to express appreciation to Dr. Hubeny and Dr. Pollock and others for the points they added.

Book Reviews

La Diathermie en Oto-Rhino-Laryngologie. By Joseph Lemoine, Assistant in Otorhinolaryngology, Hospital Bretonneau. Second edition. Paper. Price, 65 francs. Pp. 391, with 235 illustrations. Paris: Gaston Doin & Cie, 1935.

This is an interesting and very readable contribution on diathermy in otorhinolaryngology. While it cannot be considered as offering anything new or startling, it is a reliable text for reference. The bibliography, unlike that in most foreign publications, includes not only the pertinent continental literature but also what seems to be almost all the available references from the Western Hemisphere.

The work is divided into two parts. The first part is thoroughly technical, though not difficult or uninteresting. The style is didactic and simple. The reader is not burdened with a mass of formulas; on the contrary, the author resorts to excellent illustrations, of which there are two hundred and thirty-five in the entire volume, many in colors. This part deals with the general principles of electricity. In the opening chapter Lemoine reviews the physics of electricity; this discussion is purely elementary. Following this he devotes considerable space to the high frequency current and its possibilities. The first part of the treatise is concluded with a description of many types of appliances and comment on their advantages and disadvantages. This would serve only as a good review for the average science student in any American university today.

In the second part Lemoine presents the therapeutic application of diathermy. Naturally, he treats the subject in its three phases: medical diathermy, electrocoagulation and the high frequency knife. In the first chapter of this section he discusses the action of high frequency on organic tissues, also the dangers and difficulties that might be encountered. This is followed by a chapter on technic, in which he covers almost every detail. Finally he outlines the application of diathermy in specific conditions. In regard to the treatment of allergies, neuralgias and spasmodic conditions he simply states that diathermy is undoubtedly of value. So far as medical diathermy is concerned in other conditions, for example, impairment of hearing, he rather dodges the issue and cites other authorities. He believes that electrocoagulation is the method of choice in lupus and tuberculosis; nasal and pharyngeal obstructions of the cicatricial type, congenital or acquired; angiomas of the mucosa and exeresis of the tonsils. He is not dogmatic in his discussion of the tonsil problem. He states his position clearly at the outset. He does not maintain that the use of the high frequency current can or should replace orthodox surgery, but states that there are conditions in which it is preferable. He enumerates other conditions in which electrocoagulation and the cautery knife can be used to advantage.

He presents this publication guardedly, realizing that the knowledge of diathermy is still more or less in a formative period, but is confident that further research will more definitely place it as a therapeutic agent.

News and Comment

SOCIETY OF PLASTIC AND RECONSTRUCTIVE SURGERY

The Society of Plastic and Reconstructive Surgery will meet at the Chalfonte-Haddon Hall Hotel, Atlantic City, on June 14 and 15. A variety of papers and exhibits will be presented.

Directory of Otolaryngologic Societies *

FOREIGN

Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Prof. Gunnar Holmgren, Karolinska Mediko Kirurgiska Institut, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143, Groningen, The Netherlands.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John J. Shea, 1918 Madison Ave., Memphis, Tenn.
Secretary: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Place: Atlantic City, N. J. Time: June 10-14, 1935.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Wells P. Eagleton, 15 Lombardy St., Newark, N. J.
President-Elect: Dr. Frank E. Burch; 408 Peter St., St. Paul.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Cincinnati. Time: Sept. 14-20, 1935.

American Bronchoscopic Society

President: Dr. Henry Hall Forbes, 40 E. 61st St., New York.
Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.
Place: Toronto, Canada. Time: June 1, 1935.

American Laryngological Association

President: Dr. Dunbar Roy, 113 N. Pryor St., Atlanta, Ga.
Secretary: Dr. W. V. Mullin, 9204 Euclid Ave., Cleveland.
Place: Toronto, Canada. Time: May 29-31, 1935.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Perry G. Goldsmith, 170 St. George St., Toronto, Canada.
Secretary: Dr. R. L. Loughran, Sharon, Conn.
Place: Toronto, Canada. Time: June 3-5, 1935.

SECTIONS:

Eastern.—Chairman: Dr. Frederick T. Hill, Professional Bldg., Waterville, Maine.
Southern.—Chairman: Dr. Beverly R. Kennon, Medical Arts Bldg., Norfolk, Va.
Middle.—Chairman: Dr. Daniel W. Layman, Medical Arts Bldg., Indianapolis.
Mid-Western.—Chairman: Dr. Edward H. Cary, Medical Arts Bldg., Dallas, Texas.
Western.—Chairman: Dr. Frank A. Burton, Bank of America Bldg., San Diego, Calif.

American Otological Society

President: Dr. S. J. Crowe, Johns Hopkins Hospital, Baltimore.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.
Place: Toronto, Canada. Time: May 27-29, 1935.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.